Operating instructions

INTEGRAL T

Process thermostats
T 1200 (W), T 2200 (W),
T 4600 (W), T 7000 (W), T 10000 (W)

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translation of the original operating instructions
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Prefixed safety notes

Before you operate the equipment please read carefully all the instructions and safety notes. If you have any questions please phone us!

Follow the instructions on setting up, operation etc. This is the only way to exclude incorrect operation of the equipment and to ensure full warranty protection.

- Transport the equipment with care!
  Careful transportation of the equipment requested!
  The unit may NEVER be overturned nor put upside down!
- Equipment and its internal parts can be damaged:
  - by dropping,
  - by shock.
- Equipment must only be operated by properly instructed personnel!
- Never operate the equipment without heat transfer liquid!
- Do not start up the equipment if
  - it is damaged or leaking
  - the supply cable is damaged.
- Switch off the equipment and pull out the mains plug for:
  - servicing or repair,
  - before moving the equipment!
- Drain the bath before moving the equipment!
- Have the equipment serviced or repaired only by properly qualified personnel!

The Operating Instructions include additional safety notes which are identified by a triangle with an exclamation mark. Carefully read the instructions and follow them accurately!
Disregarding the instructions can have serious consequences, such as damage to the equipment, damage to property or injury to personnel.

We reserve the right to make technical alterations!

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Special symbols:

	Danger:	This symbol is used where there may be injury to personnel through incorrect handling.
+	Note:	Here special attention is drawn to some aspect. May include reference to danger.
a	Reference	Refers to additional information in other sections.

1 Safety notes

1.1 General safety notes

A LAUDA process thermostat is intended for heating or cooling and circulating liquids. This leads to hazards through high or low temperatures, excess pressures, fire and the general hazards through the use of electrical energy.

The user is largely protected through the application of the appropriate standard specifications.

Additional hazards may arise from the type of material being thermostated, e.g. when going above or below certain temperature levels or through breaking of the container and reaction with the heat transfer liquid.
It is not possible to cover all possibilities; they remain largely within the responsibility and the judgement of the user.

+ The equipment must only be used as intended and as described in these Operating Instructions. This includes operation by suitably instructed qualified personnel.

The units are not designed for use under medical conditions according to DIN EN 60601-1 or IEC 601-1!

1.2 Other safety notes

- Operation with water as heat transfer liquid (a 6.4).
- Connect the equipment only to an earthed supply socket.
- Parts of the hose connectors and of the external circuit may reach surface temperatures above 70 °C when operating at higher temperatures. Take care when touching them!
- Use suitable hoses (a Section 6.4).
- Protect tubing with hose clips against slipping off. Prevent kinking of tubing!
- Check tubing from time to time for possible material fatigue!
- Heat transfer tubing and other hot parts must not come into contact with the supply cable!!
- Failure of tubing may cause leaking of hot liquid, a danger to personnel and objects.
- Allow for expansion of the bath oil at elevated temperatures!
- Depending on the heat transfer liquid used and the method of operation it is possible for toxic vapours to be produced. Ensure appropriate ventilation!!
- When changing the heat transfer liquid from water to oil for temperatures above 100 °C carefully remove all traces of water, also from tubing and from the external circuit, otherwise à danger of burns through delayed boiling!
- Always pull out the mains plug before cleaning, maintenance or moving the thermostat!
- Repairs must only be carried out by properly qualified personnel!
- The cooling machine for type T 10000 (W) is put into category II according to the guideline 97/23/EG for pressure machines. A special final test, including a pressure test at a test pressure of 31 bar at the high-pressure side and of 25 bar at the low-pressure side.
  The relevant prescriptions regarding the operation of installations in need of observation must be taken into consideration as well as the maintenance of industrial health and safety standards. For Germany this includes also the prescriptions for operational safety (Betriebssicherheitsverordnung - BetrSichV), the rules for prevention of accidents “Refrigerating Plants, Heating Pumps and Cooling Systems” (Unfallverhütungsvorschriften BGV D4) as well as “Electrical Installations and Operating Material (BGV A2).

· Values for temperature control and indicating accuracy apply under normal conditions according to DIN 12876. High-frequency electromagnetic fields may under special conditions lead to unfavourable values. This does not affect safety!

Classes in the EMC standard DIN EN 61326-1.
Class A: Operation only on electrical supply networks without connected domestic areas.
Class B: Equipment for operation on electrical supply networks with connected domestic areas.
With unfavorable network conditions interfering voltage variations can occur.

EMC standard DIN EN 61326-1 (corresponds to VDE 0843-20-1) Devices for Europe	(þ 9)
Devices for Canada and the USA	(þ 9)

Usage restriction

For the EMC standard DIN EN 61326-1:
Devices in **Class A** are only to be operated on electrical supply networks without connected domestic areas.

Instructions for Class A digital device, USA:

"**Note:** This equipment has been tested and found to comply with the limits for Class A digital device, pursuant to Part 15 of the FCC (Federal Communication Commission) Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense".

Instructions for Class A digital device, Canada:

"This Class A digital apparatus complies with Canadian ICES-003" (ICES = Interference Causing Equipment Standards).
« Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada ».

Applicable only to water-cooled devices:

· Danger of corrosion of the cooling water circuit due to water of unsuitable quality (ð 6.4).

· Secure the return hose of the water cooling in the discharge area in order to prevent the hose sliding off uncontrollably, also during pressure surges.

· Secure the return hose of the water cooling in the discharge area so that it is not possible of hot cooling water to splash out.

· Avoid kinking or crushing the return hose of the water cooling. Excessive pressure can cause the cooling water hoses to tear and hot water to escape.

· To avoid damage due to a leak in the cooling water system we recommend the use of a water leakage sensor with water cut-off.

2 Brief instructions

These brief instructions are intended to provide you with a quick introduction to operating the equipment. For reliable operation of the thermostats it is however absolutely essential that you read carefully the full Operating Instructions and observe the safety notes!

1. Set up the equipment and add further items as appropriate (a Section 6.1).
   The unit may NEVER be overturned nor put upside down!
   Note the details on the hose connections (a Section 6.2 and 6.4).

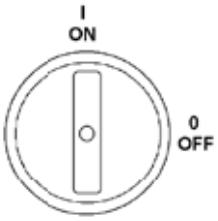
2. Fill the equipment with the appropriate heat transfer liquid (a Section 6.4). The equipment is designed for operation with non-flammable and flammable liquids to DIN EN 61010-2-010. Note liquid level! (a Section 6.2)

The T 4600 (W), T 7000 (W) and T 10000 (W) should not be filled with pure water, but only with a water-glycol mixture (minimum 70 % : 30 %) or Kryo 30!

3. Connect the equipment only to a supply socket with protective earth contact. Check the details on the rating label against the supply voltage.

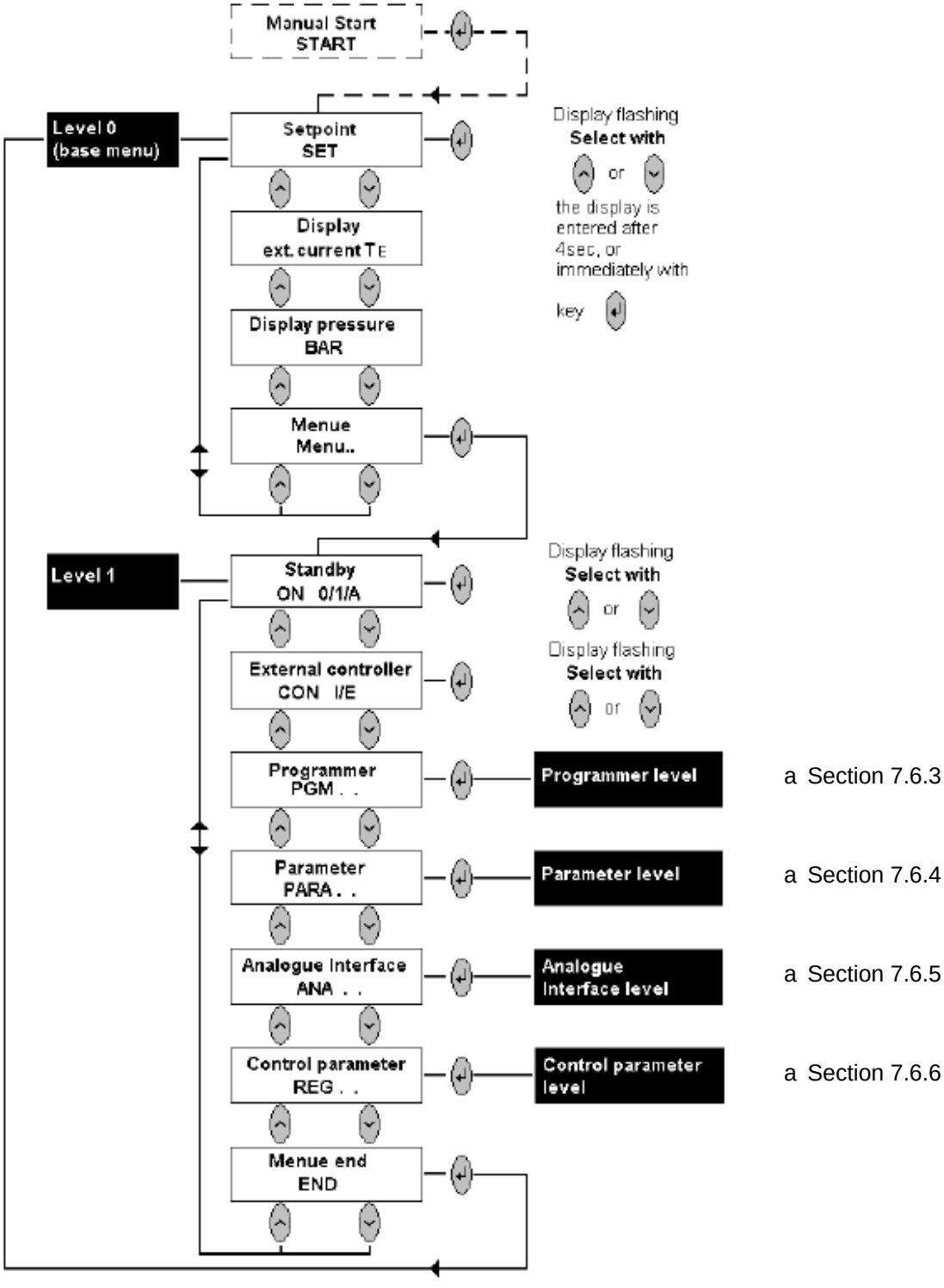
4.

Set the overtemperature switch-off point to a value clearly above ambient temperature (a Section 7.8.1).

5. Switch on the equipment or 

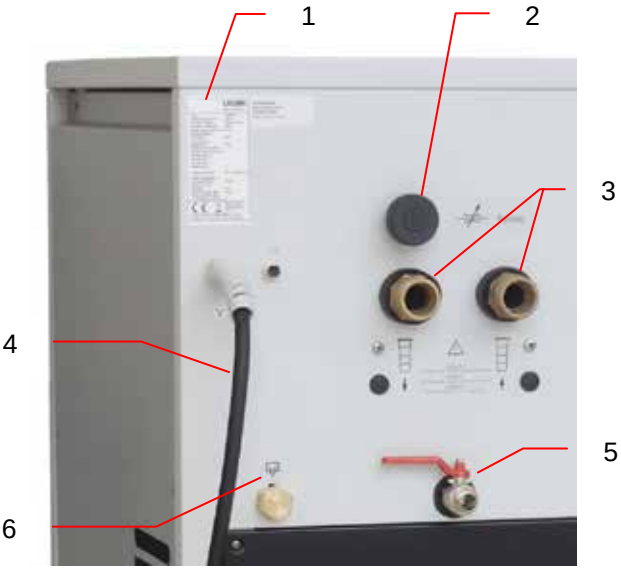
6. The function “Manual Start” (display STArt) is activated. To start the unit and enter the basic menu, press the key .

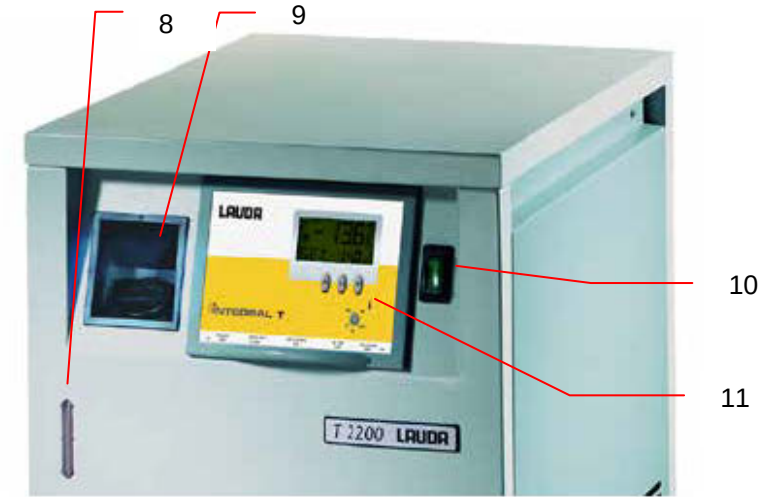
7. Equipment setup



The Parameter menu includes a default function (a Section 7.6.4.8) which produces a basic adjustment of nearly all functions and permits basic operation with internal control.

3 Control and functional elements





1. Rating label
2. Bypass adjustment
3. Pump connections
4. Mains cable
5. Drain cock
6. Overflow
7. Exit and entrance cooling water connections R3/4” (only water cooled devices W).
8. Level indication (þ 6.2)
9. Filler opening for heat transfer liquid
10. Mains supply switch
11. Menu functions
12. Control unit tilted (þ 4.7 and 4.8)

4 Equipment description

4.1 Environmental conditions

The operation of the thermostats is only allowed under the following conditions as specified in DIN EN 61010-2-010:2003 and DIN EN 61010-1:2001:

- Indoor use.
- Altitude up to 2000 m above sea level.
- Foundation must be dense, even, non-slippery and non-flammable.
- Keep clear distance (a Section 6.1).
- Ambient temperature range (a Section 9).
  Use only within this range for an undisturbed operation.
- Mains supply voltage fluctuations (a Section 9).
- Maximum relative humidity 80 % for temperatures up to 31 °C, decreasing linearly to 50 % relative humidity at 40 °C.
- Transient over voltage according to Installation Categories (Over voltage Categories) II.
- Pollution degree: 2.

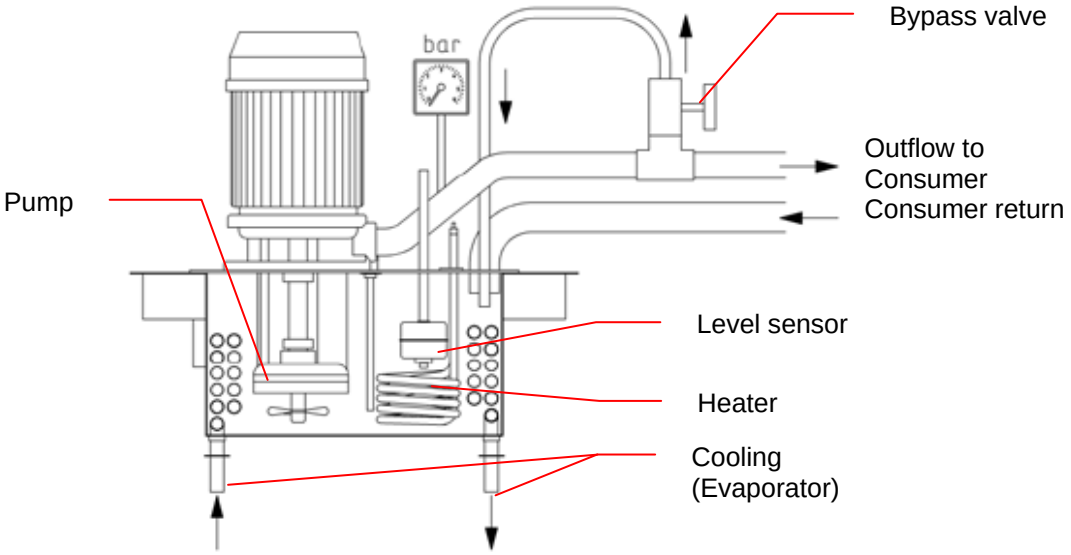
4.2 Equipment types

Integral process thermostats are identified by the letter T in the type designation. The number which follows refers to the cooling capacity at 20 °C outflow temperature. Types with the letter W at the end operate with a water-cooled condenser.

4.3 Basic principle

Integral T process thermostats are powerful heating/cooling circulation thermostats with a very small active bath volume. A largely thermally inactive bath volume serves as additional expansion space.

The heating and cooling capacities are suitably matched in order to achieve rapid temperature change both in the heating and in the cooling range.



4.4 Bath, pump

The relatively small bath contains the functional elements such as tubular heater, pump for external circulation, evaporator or pump for internal circulation on units from T 4600, temperature probe and low-level sensor.

In addition there is a larger expansion volume which is only partially thermally active. The front of the equipment carries a level indicator.

The connections and sizes for the external thermostating circuit are selected to be suitable for the pump output.

All pumps are immersion pumps. An adjustable bypass between liquid outlet and bath allows the pressure to be reduced (a pump characteristics, Section 9).

A pressure sensor at the pump outlet measures the actual discharge pressure which can be indicated on the display for monitoring purposes.

4.5 Materials

All components in contact with the heat transfer liquid are made from materials suitable for the recommended liquids (a Section 6.3) and temperature. The materials used are rust free stainless steel, copper, brass, NBR, plastics.

4.6 Refrigeration unit

The refrigeration unit consists essentially of a fully sealed compressor. The heat transfer liquid is cooled through a heat exchanger located inside the bath, or on the more powerful units (from T 4600) via a separate circuit with its own pump using a plate heat exchanger. Heat of condensation and motor heat are dissipated on air-cooled units through a fan-cooled ribbed condenser on water-cooled units through a counter-flow heat exchanger with the water flow controlled by the condenser pressure.

The refrigerant used throughout is HFKW R 404 A. The refrigeration unit is protected against overpressure and compressor overload. With insufficient ventilation of the condenser (e.g. dirt deposits) or in the absence of cooling water (e.g. water tap not opened) the equipment is switched off.

4.7 Control unit, control and safety circuit

The control unit with indication and operating functions, and also the connector for the electrical interfaces can be tilted into two positions. This ensures improved reading and protects the plug connections.

The equipment is provided with a 2-line LC display to indicate the measurements and settings as well as the operational status. The setpoint and other settings are selected under menu guidance using two or three keys.

A Pt100 temperature probe senses the outflow temperature inside the bath. The measurement is processed by a high-resolution AD converter. Further processing involves a special control algorithm to operate the heating triac (with reduced reaction on the mains supply), the automatic compressor control, and the cooling control which operates with low-noise solenoid valves. The LAUDA proportional cooling principle permits control in the cooling range without any energy-wasting counter-heat.

On single-phase units (T 1200 – T 2200 W) the maximum heater power is reduced to 1500 W while the compressor is running in order to limit the current uptake.

An external Pt100 for sensing an external temperature can be connected to a socket (10S). This value can be indicated and used (if required) as controlling variable when the external controller (cascade control) is activated. The system is then controlled from the external measurement and not from the outflow temperature

The safety system corresponds to that for laboratory liquid thermostats and conforms to DIN EN 61010-2-010. A double-channel system is employed with the two micro controllers checking each other. There is a low-level sensor and a second bath temperature probe (Pt100) used in the safety circuit to switch off in case of over temperature and for checking the measuring/ control probe

The over temperature switch-off point is adjusted with a screwdriver (tool) on the control unit. The setting is also automatically indicated on the display.

With low liquid level, over temperature and certain system faults the heating is switched off on all poles. The pump and refrigeration unit are also switched off. This fault shut-down is permanent, i.e. the blockage is stored in the memory and has to be reset by operating the key after the fault has been rectified. The fault blockage is retained after the mains supply is switched off.

Other equipment functions are described in the appropriate Sections and in Section 7.

4.8 Interfaces

Connectors for standby contact input, fault (alarm) contact output, analogue inputs and outputs, external Pt100 and serial RS232/RS485 interfaces are accessible from below after swinging out the control unit. The control unit can be swung out to position 2 for making the connections, and can then be returned to position 1.

Position 1

Position 2

For additional description of the interfaces see under Section 7.7 and Section 7.

4.9 Options

The options installed in the device are to be recognized by a label next to the type designation plate.

4.9.1 Enlarged temperature range to 150 °C, Option 1

The device is modified so that the upper limit of the working temperature range is expanded from 120 °C to 150 °C.

An additional fan is built in at the back side. Do not close the aspirating hole!

In particular it is to be noted that with temperatures exceeding 120 °C metal tubing is used!

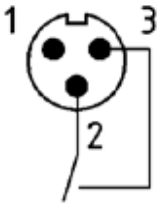
4.9.2 High-power pump, Option 3

A high-power 2-stage pump with maximum values 5.5 bar/40 L/min is installed. Pump characteristics (ð Section 9 Technical Data).
The units T 1200 ... T 2200 W have a larger overall height (ð Section 9 Technical Data). The cooling capacity is reduced by approx. 200 W.

4.9.3 Flow control instrument, Option 5

In the return line for the heat transfer a paddle flow control instrument is installed. The contact is connected to the backside flanged 3 pole plug.

The contact closes at Q > 5 L/min with T 1200 ... T 4600 W and Q > approx.10 L/min with T 7000 ... T 10000 W.



- View on flange plug (Front) or solder side coupler socket.
- Maximum contact load 30 V; 1 A.

+

- Use shielded lines.
- Connect shielding with connector housing.
- Cover unused plug connections with protecting caps!

Coupler socket Cat. No. EQD 047

4.9.4 Low pressure pump, Option 6

Only at T 1200 (W) and T 2200 (W)!

This is a 2-stage radial disc pump with a maximum pressure of 1 bar and a maximum pump output/ flow rate of 30 L/min. This pump has a smaller noise level and in most cases can be used to temper glass instruments. Pump characteristics (ð Section 9 Technical Data).

5 Unpacking

Keep your original packing of your thermostat for later transport.

After unpacking, check first the equipment and accessories for possible transport damage. If unexpectedly any damage can be noticed on the equipment it is essential to notify the forwarding agent or the postal authorities so that an inspection can take place.

Please also inform the LAUDA Service Constant Temperature Equipment (Contact ð 8.8).

Do not start operations with damaged instruments!

The unit may NEVER be overturned nor put upside down!

Standard accessories

Quantity	Article	for device	Cat. No.
1	Operating Instructions	for all devices	YAWE 0026
1	Plug for filler opening	for all devices	EZV 086
2	Nipples 3/4" with thread	T 1200 (W), T 2200 (W), T 4600 (W)	EOA 004
2	Nipples 1" with thread	T 7000 (W), T 10000 (W)	EOA 036
2	Water hoses, 4 m each, with quick-release coupling and hose clips	for water-cooled devices (W) ½“ T 1200 W, T 2200 W, T 4600 W, T 7000 W ¾“ T 10000 W	 LWZ 025 LWZ 026

For further accessories please contact us (a 8.8).

6 Preparations

6.1 Assembly and setting up

It is advisable to set up the equipment so that the control unit is towards the front and that the ventilation for the refrigeration unit, especially on equipment with air-cooled condenser, (ventilation grille in lower part) is not impeded. Ensure a minimum spacing of 0.5 m between ventilation grille and wall.

Lock the front castors where appropriate.

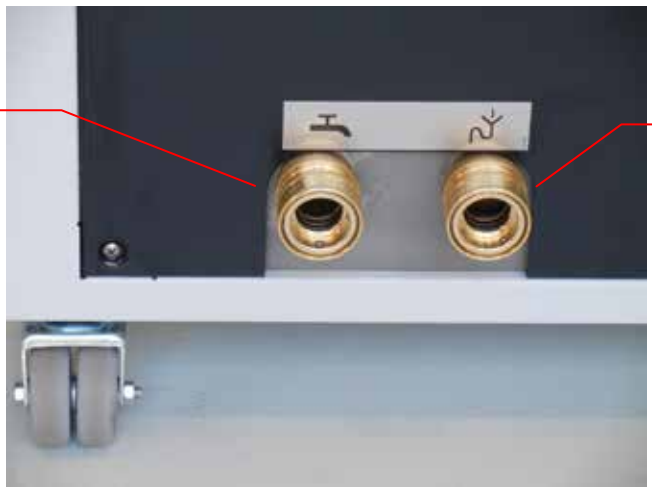
Check that the drain cock is closed.

If necessary open the overflow at the back of the equipment and place a vessel underneath it. For this operation turn the closing plug approx. 45° anticlockwise until the hose end ears can be pulled out through the openings in the housing.

The overflow is required where it is possible for larger volumes of the heat transfer liquid in the external circuit to drain back.

Water-cooled version

The heat of condensation and the motor heat are dissipated through a water-cooled counter flow heat exchanger. Connect up the hoses. The connection for inlet (from water tap) and outlet (to drain) are located on the back of the equipment at the bottom. Inlet on the left, outlet to drain on the right, looking on the back of the equipment. The cooling water flow is automatically adjusted to the required amount through the condenser pressure.



Secure the hoses with hose clips to prevent slipping off!!

The water consumption depends on the energy to be dissipated. It ranges between 200 and 2000 L/h depending on equipment type, cooling water temperature and loading. The cooling water temperature must not exceed 25 °C. Cooling water pressure should be > 2.5 bar. The maximum overpressure must not exceed be 10 bar.

Connection of the cooling water

Note that the following conditions apply for the connection of the cooling water supply:

Cooling water pressure (feed - outlet)	maximum 10 bar overpressure
Differential pressure r p (feed - outlet)	minimum 2.5 bar
Cooling water temperature	10 to 15 °C recommended, 10 to 25 °C not exceed (with power restrictions)
Cooling water quantity	see Technical Data (a 9)
Cooling water hose for connection to the device	minimum 13 mm

6.2 Filling and connection of external circuit

Fill the equipment with heat transfer liquid to suit the operating temperature.

+ **Note:** The T 4600 (W), 7000 (W) and 10000 (W) should not be filled with pure water, but only with Kryo 30 or a water-glycol mixture (minimum 70 % : 30 %)!

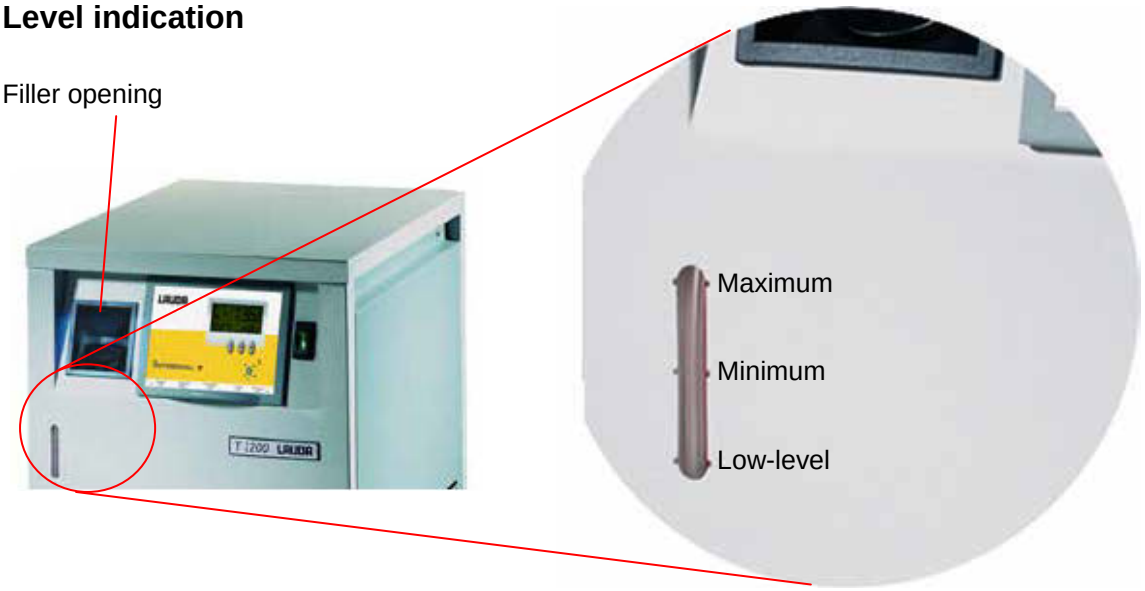
When using water as heat transfer liquid at T 1200 and T 2200 please make sure that there are no operating temperatures below 5 °C in the outflow. Set the outflow temperature limitation TiL to 4 °C! (a Section 7.6.4.4).
Use Kryo 30 (ð Section 6.4) if you are not sure!

To assist in venting the pump, the pressure connection should be left open when the equipment is filled for the first time, otherwise there may be permanent damage to the pump!

Remove the plug on the filler opening at the front. A funnel can be used for filling.

When starting up for the first time, fill the bath as full as possible, up to the maximum level indication. After filling up an external circuit further heat transfer liquid may have to be added.

Level indication



- **For operating temperatures above 50 °C fill up to “normal”.**
  In case of larger bath volumes open the overflow. (a Section 6.1).
- For operating temperatures below 0 °C fill up to “maximum” if possible in order to allow for volume changes.
- For optimum operation, the bath level must be between "minimum" and "maximum".

Connect the pump connections at the back of the equipment to the external circuit. The external circuit must be pressure-tight.

+ - Switch off the equipment before releasing the hose connections; the hose couplings are not self-sealing!

The pumps installed in the equipment can produce pressures above 1 bar which can cause breakage of glass apparatus!
Note the maximum permitted pressure of the apparatus in the external circuit!
Pressure limitation through bypass (a Section 7.2).

For suitable hose material, please see (a Section 6.4).

With external circuits at a higher level, even with a closed circuit, the external volume may drain down when the pump is stopped and air enters the thermostating circuit; this may result in overflowing of the storage bath!

Use only hydraulic closed consumers.

Always ensure maximum flow cross-section in the external circuit (nipples, tubing, external apparatus). This results in increased flow rate and therefore better thermostating.

Protect tubing against slipping off by fitting hose clips!

\+

- The equipment is designed for operation with non-flammable and flammable liquids in accordance with DIN EN 61010-2-010.
  Flammable liquids must not be used at temperatures higher than 25 K below the fire point.

6.3 Emptying

\+

- Place a container underneath the drain cock on the back of the equipment. Switch off the equipment!
- Observe the appropriate regulation when disposing of used heat transfer liquid.
- Close the drain cock!

Drain cock

Do not drain the heat transfer liquid when it is hot or at temperatures below 0 °C!

6.4 Heat transfer liquids, cooling water and hoses

a) Approved heat transfer liquids

LAUDA designation	Working temperature range	Chemical designation	Viscosity$_{(kin)}$ @ 20 °C	Viscosity$_{(kin)}$ at temperature	Fire point	Container size Catalogue number		
	from °C to °C		mm²/s	mm²/s	°C	5 L	10 L	20 L
Aqua 90 ƒ	5 ... 90	decalcified water •	1	--	--	LZB 120	LZB 220	LZB 320
Kryo 30 ,	-30 ... 90	Monoethylene -glycol/ water	4	50 at -25 °C	--	LZB 109	LZB 209	LZB 309
Kryo 51	-50 ... 120	Silicone oil	5	3 at -50 °C	> 160	LZB 121	LZB 221	LZB 321
Kryo 20	-20 ... 180	Silicone oil	11	28 at -20 °C	> 230	LZB 116	LZB 216	LZB 316
Kryo 40	-40 ... 60	Aqueous salt solution	2,4	10 at –25 °C	--	LZB 119	LZB 219	LZB 319

\+ • Distilled water or fully deionised water should only be used with the addition of 0.1 g per litre sodium carbonate (Na_2CO_3), otherwise danger of corrosion!

, Water content falls after prolonged operation at higher temperatures and mixture becomes flammable (flame point 128 °C) à check mixture ratio with a hydrometer.

ƒ Water is only allowed to be used for the models T 1200 (W) and T 2200 (W).
The T 4600 (W), T 7000 (W) and T 10000 (W) should not be filled with pure water, but only with Kryo 30 or a water-glycol mixture (minimum 70 % : 30 %)!

- When selecting heat transfer liquids it should be noted that performance must be expected to worsen at the lower limit of the operating temperature range due to increasing viscosity. The full operating range should only be utilised if really necessary.
- The application ranges of heat transfer liquids and tubing are for general information only and may be restricted by the operating temperature range of the equipment.

- Silicone oil causes pronounced swelling of silicone rubber. Never use silicone oil with silicone tubing!

Safety data sheets are available on request!

b) Cooling water

Certain requirements are placed on the cooling water with regard to purity. Depending on the cooling water contamination, a suitable method of purification and/or treatment of the water must be employed. The condenser and the complete cooling water circuit can become blocked, damaged and leaky due to unsuitable cooling water. Extensive consequential damage may arise on the whole cooling circuit. The cooling water quality depends on local conditions. If a fault or damage occurs due to unsuitable water quality, it is not covered by our guarantee.

Important: Danger of corrosion of the cooling water circuit due to water of unsuitable quality.

- Free chlorine (e.g. from disinfectants) and water containing chlorine lead to pitting in the cooling water circuit.
- Distilled, deionized or demineralized water is unsuitable due to its corrosive properties and leads to corrosion in the cooling water circuit.
- Seawater is unsuitable due to its corrosive properties and leads to corrosion in the cooling water circuit.
- Water containing iron or iron particles leads to rust formation in the cooling water circuit.
- Due to the high lime content hard water is not suitable for cooling and leads to calcification in the cooling water circuit.
- Cooling water with suspended matter is not suitable.
- Untreated and unpurified river or cooling tower water is not suitable due to its microbiological content (bacteria), which can become deposited in the cooling water circuit.
- Putrid water is not suitable.

Suitable cooling water quality

pH – value	7.5 – 9.0
Sulfates [SO_4^{2-}]	< 70 mg/L
Hydrocarbonates [HCO_3-]/ sulfates [SO_4^{2-}]	> 1.0
Total hardness	4.0 – 8.5 °dH
Hydrocarbonates [HCO_3-]	70 – 300 mg/L
Conductivity	10 - 500 µs/cm
Chlorides (Cl^-)	< 50 mg/L
Sulfites [SO_3^{2-}]	< 1 mg/L
Free chlorine gas (Cl_2)	< 1 mg/L
Nitrates (NO_3 -)	< 100 mg/L
Ammonia (NH_3)	< 2 mg/L
Iron (Fe), dissolved	< 0.2 mg/L
Manganese (Mn), dissolved	< 0.1 mg/L
Aluminum (Al), dissolved	< 0.2 mg/L
Free aggressive carbonic acid (CO_2)	< 5 mg/L
Hydrogen sulfide (H_2S)	< 0.05 mg/L
Algae growth	Not permissible
Suspended matter	Not permissible

Risk to the environment due to oil contamination of the cooling water circuit

With a leaky condenser there is the danger that refrigerating machine oil from the refrigerant circuit of the cooling thermostat can pass into the cooling water.
Follow all the legal requirements and the regulations of the water supply utility which apply at the point of use.

Water pollution due to leakage

To avoid pollution due to a leak in the cooling water system it is recommended that a leakage-water detector with a water cut-off is installed.

Servicing intervals

Follow the information for cleaning and decalcifying the cooling water circuit (ð 8.6).

c) Hoses

Tubing type/part	inner diameter Ø mm x insulation thickness	Temperature range °C	maximum working pressure in bar	Application	Cat. No.
Tubing with reinforcement EPDM	½" Ø12 x 3.5	-40 ... 120	9	for all heat transfer liquids except Ultra 350 and mineral oils; all units with ½" nipple	RKJ 103
Tubing with reinforcement EPDM	¾" Ø19 x 3.5	-40 ... 120	9	for all heat transfer liquids except Ultra 350 and mineral oils; all units with ¾"-nipple	RKJ 104
Tubing with reinforcement EPDM	1" Ø25 x 3.5	-40 ... 120	3	for all heat transfer liquids except Ultra 350 and mineral oils; all units with 1"-nipple	RKJ 105
	inner diameter Ø mm x wall thickness				
Insulation	23 x 10	-50 ... 110	---	Insulation for RKJ 103	RKJ 009
Insulation	29 x 10.5	-50 ... 110	---	Insulation for RKJ 104	RKJ 013
Insulation	36 x 11	-50 ... 110	---	Insulation for RKJ 105	RKJ 017
	inset diameter				
Hose clip	16 ... 27	---		suitable for RKJ 103	EZS 032
Hose clip	20 ... 32	---		suitable for RKJ 104	EZS 015
Hose clip	25 ... 40	---		suitable for RKJ 105	EZS 016

- EPDM tubing is not suitable for Ultra 350 and not suitable for mineral oils.
- Silicone oil causes pronounced swelling of silicone rubber. Never use silicone oil with silicone tubing!
- Protect tubing with hose clips against slipping off!

Metal hose insulated, temperature range -50 ... 150 °C; maximum working pressure 10 bar

Type	length cm	nominal width	Screw connection	Cat. No.
MTK 100	100	DN 20	G ¾	LZM 075
MTK 200	200	DN 20	G ¾	LZM 076
MTK 101	100	DN 25	G 1¼	LZM 078
MTK 201	200	DN 25	G 1¼	LZM 079

7 Starting up

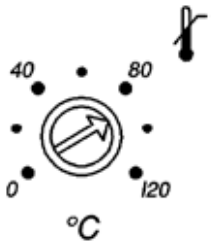
7.1 Connection to the supply

Compare the information on the equipment label with the supply details.

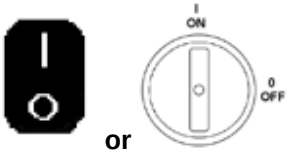
- Connect the equipment only to a socket with a protective earth (PE) connection.
- No warranty when the equipment is connected to the wrong supply!
- Ensure that the external circuit is properly connected to the pressure connections.
- Ensure that the equipment is filled in accordance with Section 6.2!
- How to disconnect in emergency cases:
  Turn main switch to **OFF** and pull the main plug.

7.2 Switching on

For consumers with a maximum permissible operating pressure below the maximum pressure of the pump, use a safety valve for protection. This safety valve must be installed in the outlet of the device.



- Using a screwdriver, set the overtemperature switch-off point to a value clearly above ambient temperature.

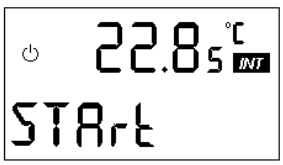


or

- Switch on at the mains switch. The green LED for “Supply ON” lights up.

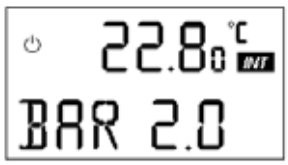
- A beep sounds for approx. 0.25 sec.

- The equipment self-test starts up. All display segments and symbols light up for approx. 1 sec. Then the software version (VERx.x) is indicated for approx. 1 sec.



- The display only appears if function "Manual Start" is activated which means that every time the unit was OFFline, it has to be started with the key .
  (a Section 7.6.4.2).
  In case "Auto start" is activated, the following display is shown immediately after unit has been switched ON.
  Attention: If the key pad is locked (KEY-function) the KEY-function must be switched OFF first.
  (a Section 7.3.2).

- On equipment types T 7000 (W) and T 10000 (W) the pump is driven by a 3-phase motor. The direction of rotation of the mains supply must be checked. If the output pressure indication (a Section 7.5) does not show a build-up of pressure, the direction of rotation of the 3phase supply has to be reversed by interchanging 2 phases!
  Warning!
  This operation must only be carried out by a qualified electrical technician!
- If no heat transfer liquid is being pumped in spite of adequate liquid level in the bath, the reason is an air pocket which prevents the pump filling with liquid. The remedy is to vent the external circuit at the highest point!



- Close the bypass valve on the back of the equipment so far (clockwise) until the maximum required pressure in the external circuit is obtained. If the pressure in the external circuit is not a critical factor the bypass valve should be closed completely. The resulting discharge pressure is indicated in digital form in the base menu. This can suggest information on the flow rate and on possible faults.
- If it is necessary to ensure that a certain pressure must not be exceeded even if the external circuit is blocked completely, proceed as follows: Close the outflow (e.g. kink the hose shut) and set the maximum permitted pressure with the bypass valve. Then open the external circuit again but do not alter the bypass valve setting!

- Display of the actual bath temperature (top) with 0.05 °C resolution and of the setpoint. The pump starts up. The values active before the equipment was switched off are entered.

+

- If necessary add more bath liquid to replace the amount pumped out to fill the external circuit.

%»

- If the low-level indication appears.
- A dual tone sounds.

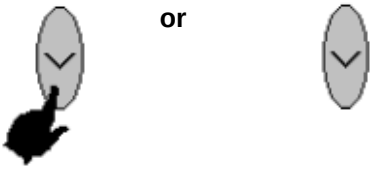
- The fault triangle is flashing.

- Press the key.
- Also press the key if the equipment had switched off in fault status due to other faults.

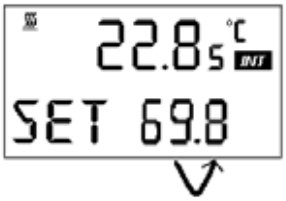
7.3 Key functions

7.3.1 General

- Change to the next level, also marked by two dots behind the symbol.
- Activates input, display is flashing.



- Scrolls with keys within the particular level,
- **or** setting numeral values.



- Accelerated input through:

a) Holding down the keys **or**

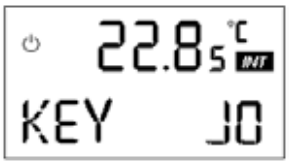
b) pressing and holding down one of the two keys and immediately afterwards pressing the other key briefly.

- Briefly (1 sec.) releasing the key(s) and again pressing one of the keys moves one digit to the right.
- **In principle:** after the setting has been completed it is entered automatically after approx. 4 sec **or**

- immediate entry of the setting with key.

7.3.2 Key inhibit (KEY)

+



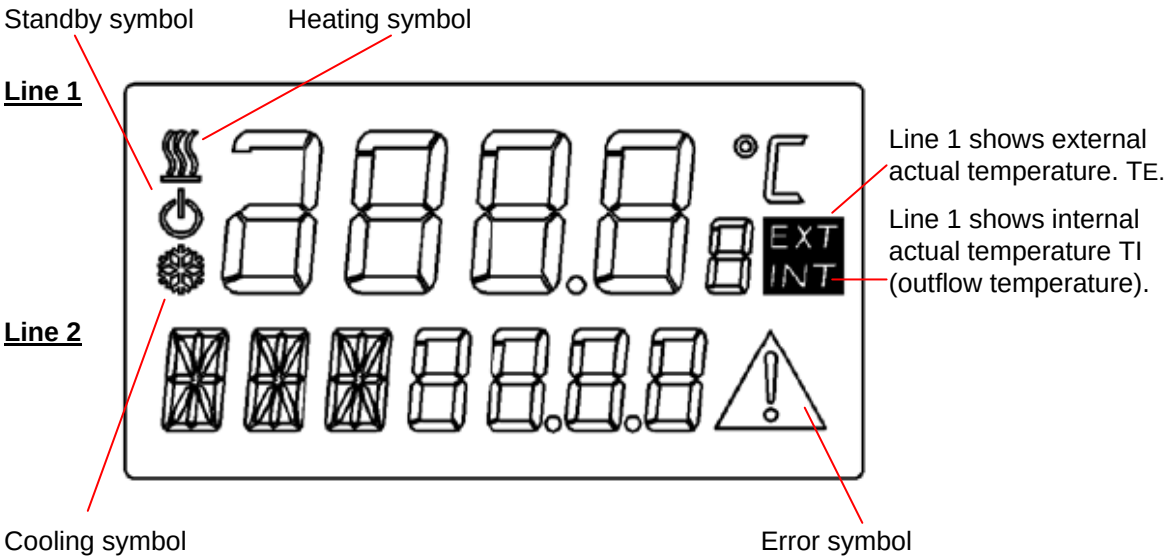
- Key operation can be inhibited with the KEY function in order to prevent unauthorised alteration of the equipment settings via the keys.
- Press key and hold it down.
- Within 4 sec press also and hold it down.
- The display shows
- and 4 x 0 appear consecutively.
- KEY is displayed.
- Release both keys.
  The keys are now non-functional. When any keys are operated the display shows KEY.

For de-inhibiting:

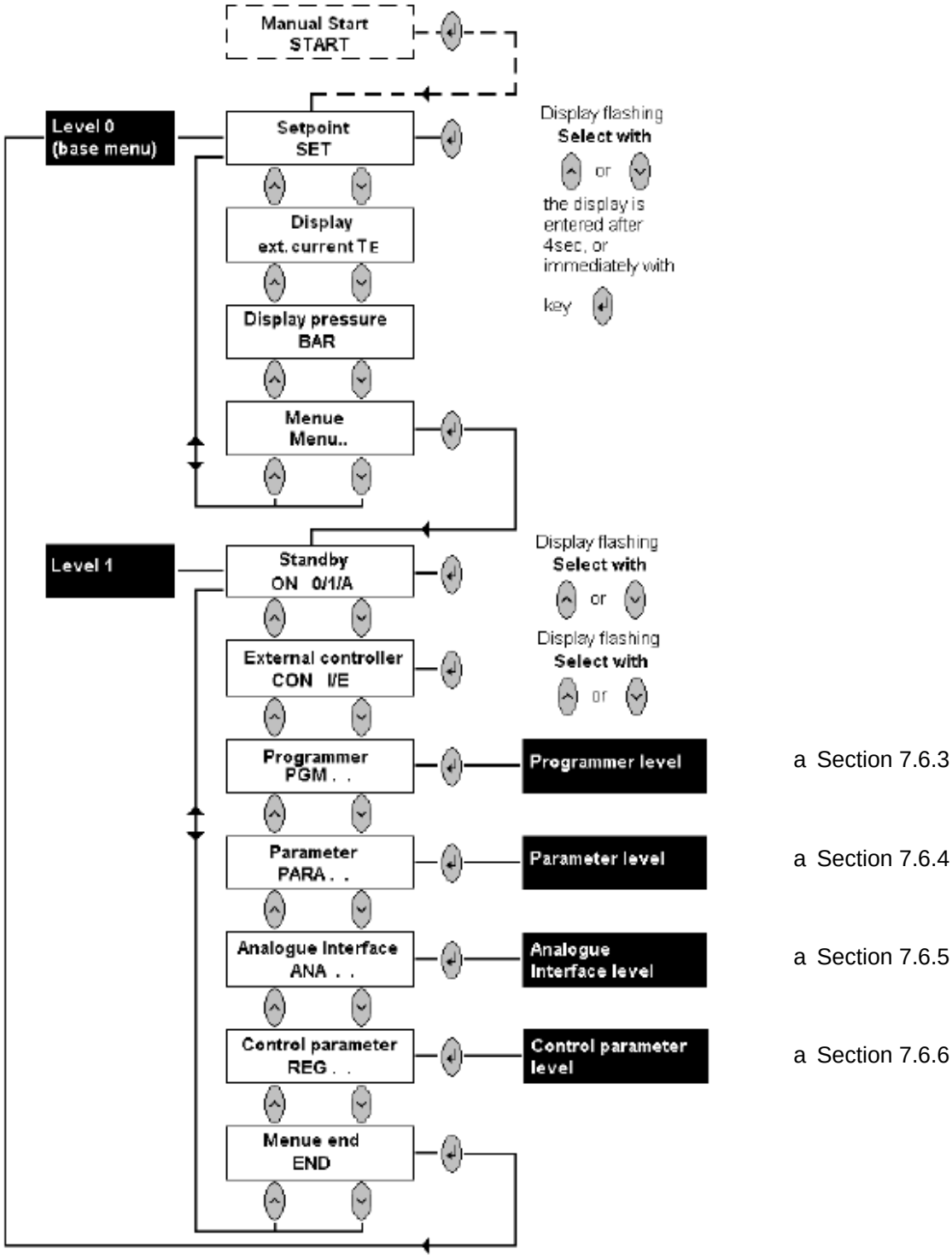
+

- Press key and hold it down,
- Within 4 sec. press also and hold it down.
- The display shows
- and 4 x 0 disappear consecutively and KEY disappears.
- The keys are de-inhibited.

7.4 LC-Display



7.5 **Level 0 (base menu)** and level 1



a Section 7.6.3

a Section 7.6.4

a Section 7.6.5

a Section 7.6.6

7.5.1 **Setpoint selection** (Level 0)

or

- Press keys until SET (Setpoint) appears.

- Enter, display is flashing.

or

- Enter setpoint with both keys (a Section 7.3.1).

- Display is flashing 4 s à new value is entered automatically, **or**

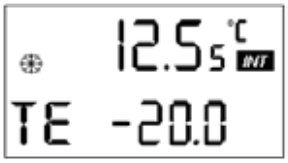
- value entered immediately with key.

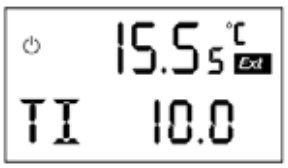
\+ - For safety reasons the setpoint can only be set up to 2 °C above the upper limit of the operating temperature range of the particular equipment type.

- Appears when analogue setpoint input is activated.

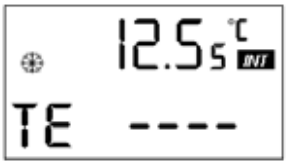
7.5.2 **External actual temperature display**

- switches line 2 of the display from setpoint SET to the external actual temperature TE,





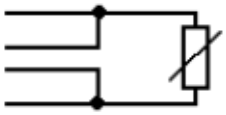
- or internal actual temperature (outflow temperature) TI if external control is activated.



- When external Pt100 is not connected.

Connection of the external Pt100 to Lemo socket 10S:

Pin			
1	+	I	Current path
2	+	U	Voltage path
3	-	U	Voltage path
4	-	I	Current path



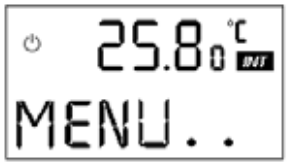
Pt100
DIN EN 60751

- 4-pin Lemosa plug for Pt100 connection (Cat. No. EQS 022).
- Use screened connecting cable. Connect screen to connector case.

7.5.3 Pressure indication

- Line 2 indicates the pump pressure which establishes itself through the flow resistance in the external circuit.
- This indication is also required for adjusting and monitoring the bypass.
- The actual pump flow rate can be deduced from the pump characteristic.

7.5.4 Menu . .



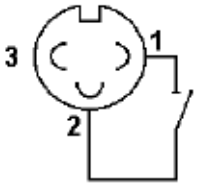
- Scroll to level 1.

7.6 Level 1

- see (a 7.5).

7.6.1 Standby (ON)

- Three operating modes can be selected, Display is flashing.
- 0 = equipment on standby: pump(s), heating, refrigeration unit OFF. Control unit and displays are operating. The symbol ⏻ in the display on the left is alight.
- 1 = Equipment in operation **(ON)**.
- A = automatic operation standby and equipment ON are selected by contact at socket 16N.
  Contact closed = equipment **ON.**
  Contact open = equipment **OFF**, standby.
- View of socket (front) and plug solder face! Signal approx. 5 V, 10 mA.
  Do not use pin 3!



3-pin coupling connector Cat. No. EQS 048.

7.6.2 External control (CON)

External control can be activated here:

- I = internal control, the equipment is controlled by the outflow temperature.

- E = external control **ON**, the control operates as cascade controller from the external actual temperature.
- With external control switched on, line 1 of the display automatically shows the external temperature. The indicator field changes from INT to EXT.
- The external actual temperature is normally sensed by the Pt100 connected to socket 10S (a Section 7.5.2). The external actual value can also be introduced as a standard signal (socket 66S).

- No Pt100 is connected to socket 10S and no standard analogue signal is switched on (66S), the display shows **FAIL** when an attempt is made to activate external control.

- Reset with key.

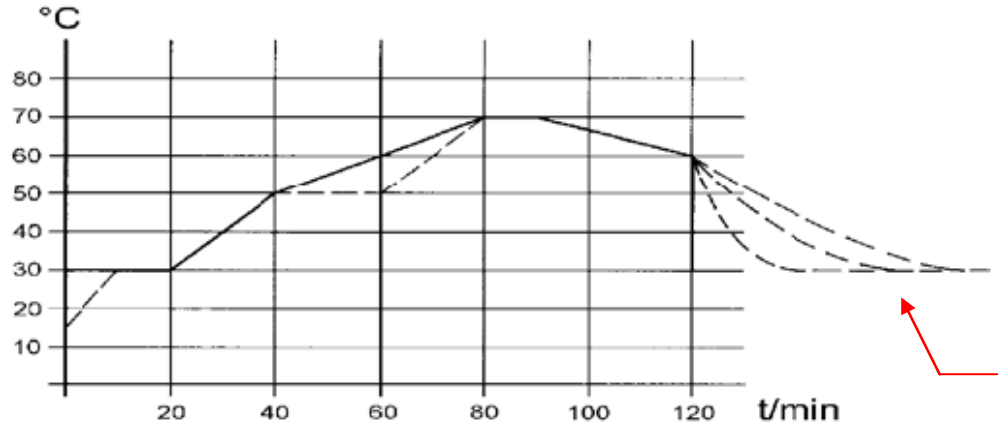
7.6.3 Programmer level (PGM)

The programmer function of the units permits storage of 5 temperature-time programmes. Each **programme** consists of several temperature-time segments. In addition there is the information how many times the programme should be run (**LOOP**). The total number of all the segments of all programmes must not exceed 150.
A segment is normally a **ramp** which is defined by the target temperature, i.e. the temperature at the end of the segment, and the duration from the start to the end of the segment.
It is possible to have **temperature steps**, i.e. the time is zero, and also **temperature hold phases**, i.e. the same temperature at the start and at the end of a segment.
At the start of the programme the current actual temperature is taken as the start temperature of the first segment.

+

- It is recommended to adjust the setpoint to a defined value before the start of the programme, and to terminate the programme at the same temperature.
- The programmer can also be operated or modified via the RS232.

7.6.3.1 Example of programme

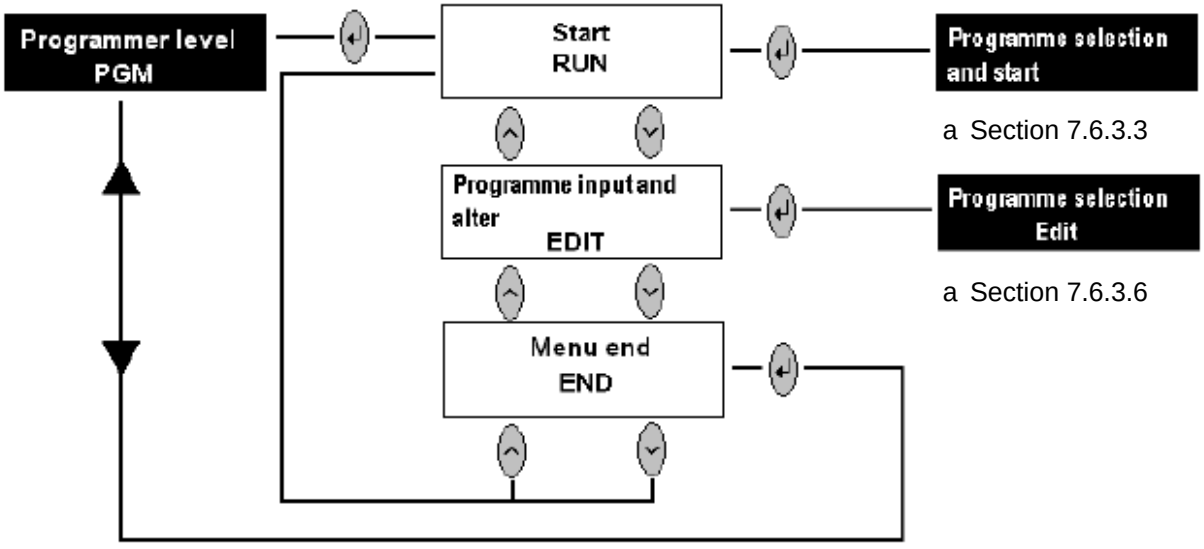


Original programme example			Edited programme example		
Segment	Temperature °C	Time min	Segment	Temperature °C	Time min
1	30,0	20	1	30,0	20
2	50,0	20	2	50,0	20
3	70,0	40	3	**50,0** •	**20** •
4	70,0	10	4	70,0	**20** ,
5	60	30	5	70	10
6	30	0	6	60	30
			7	60	0

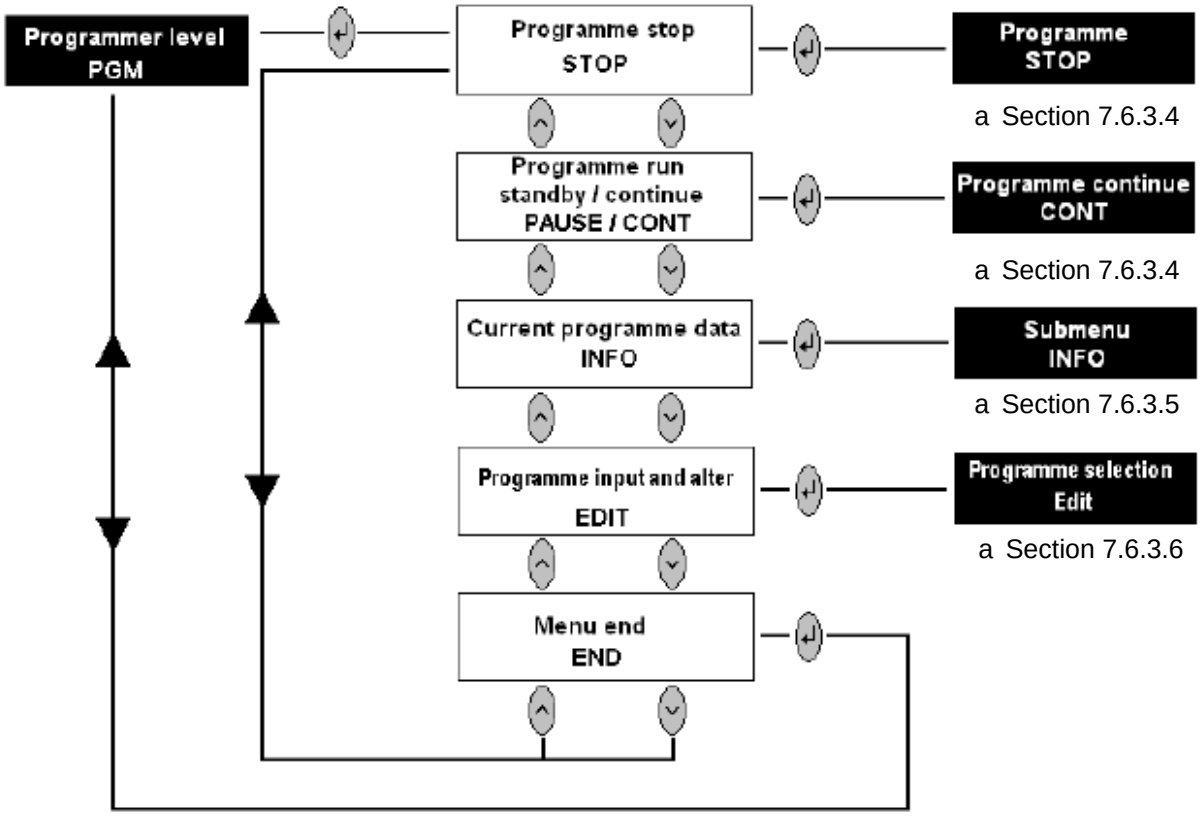
- Insert new segment (a Section 7.6.3.6).

, Alter segment time (a Section7.6.3.6).

7.6.3.2 Menu structure



or, when programme is running



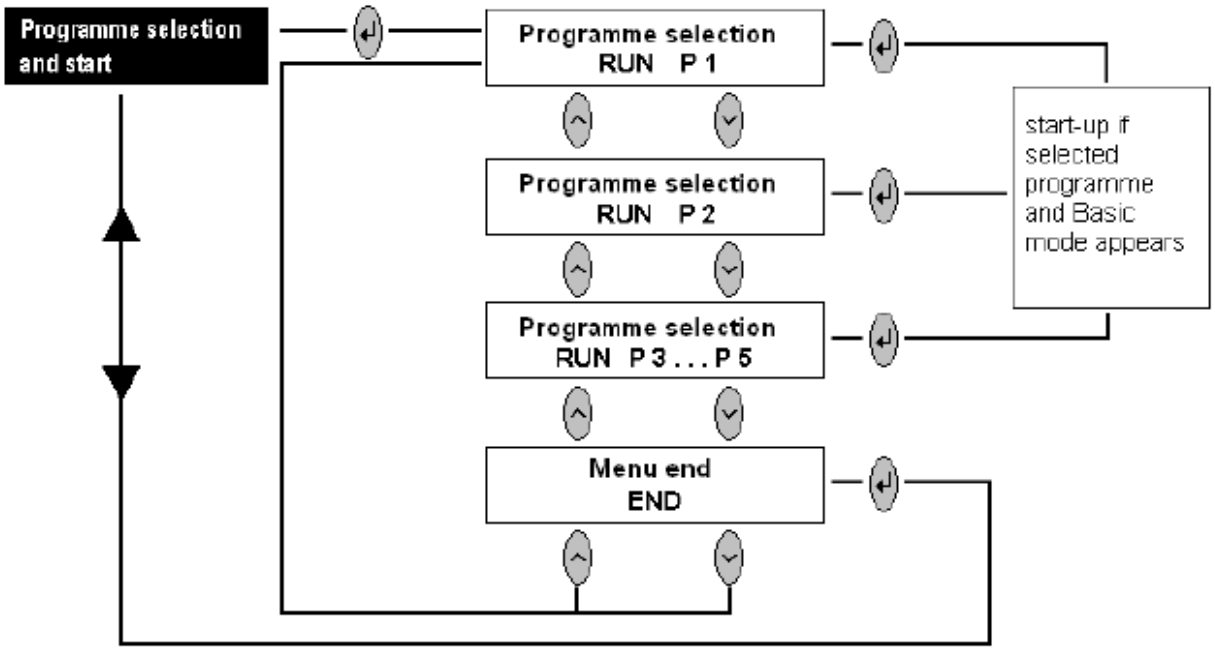
a Section 7.6.3.4

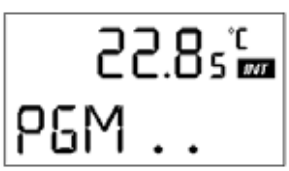
a Section 7.6.3.4

a Section 7.6.3.5

a Section 7.6.3.6

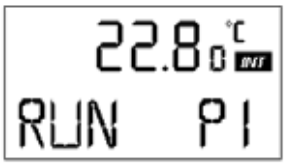
7.6.3.3 Programme selection and start





- Press the key to go to the submenu of the programmer function.

- Press the key to go to programme selection.

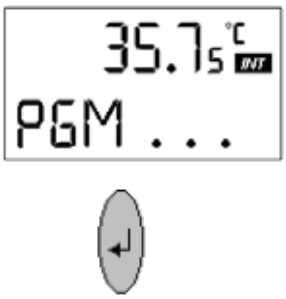


- Press the keys to go to the programmes P 1, P 2 .... P 5, **or** backwards.

- Key starts the programme. Display changes to basic menu (level 0) and shows e. g. P 1 (instead of SET). P 1 blinks briefly; this indicates that the programme is running. On selecting a programme number which has not been configured with a programme, the basic menu shows SET.

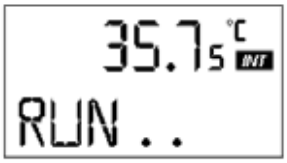
7.6.3.4 Terminate, pause, continue the programme

Terminate:



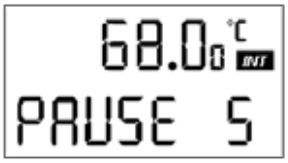
- On going into the PGM menu while a programme is running, the display shows STOP and the programme number.

- I. e. pressing the key terminates the programme run. The final setpoint is retained.



- You are at the beginning of the start menu. The programme can be started from the beginning (segment 01)
  (a Section 7.6.3.3) or you can exit the menu with END (a Section 7.6.3.2).

Pause:



- With the instruction PAUSE the programme run is stopped (held) at the current position. The display changes to CONt.

- You can exit the menu with END in the usual way.

Continue:

- Pressing the key continues the programme at the point where it has been stopped (held).

- After the supply has been OFF and ON again while the programme is running, the programme is pause (held), i.e. it can be continued with CONt.

7.6.3.5 INFO submenu

- In this area the current programme data can be indicated at any time while the programme is running.
  (a Section 7.6.3.2).

- With this key from PAUSE or CONt to the INFO menu.

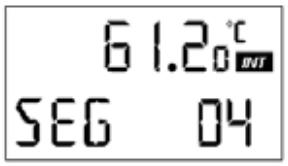
- On pressing this key, line 2 of the display shows the number of the programme selected.

- Line 2 shows programme 5.

- Pressing the key changes the display to the current programme LOOP.

- “1“ means that the programme is running in the first of the programmed runs.

- Pressing the key changes the display to indicate the current segment number.



- Pressing the key changes the display to indicate the elapsed time in minutes for the current segment.

- You can exit the INFO submenu in END.

7.6.3.6 Edit submenu

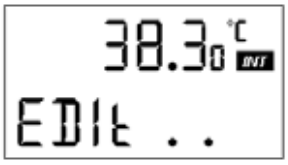
Here there are the following functions:

- Select programme.
- Input a programme.
- Show the programme data of a stored programme and alter the segment data.
- Insert or add a new segment.
- Delete a segment.
- Input the number of programme runs.

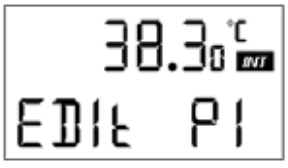
- Programme alterations are stored permanently only after exit from the Edit menu.

+ - When the programmer is activated, new segments can be inserted and existing segments can be altered, incl. The one which is currently activated. In addition, all segments can be deleted at any time with the exception of the one currently activated.
  - Alterations are possible while the segment is running. The segment is continued as if the alteration had applied since the start of the segment.
  - **But:** if the new segment time is shorter than the segment time which has already elapsed, then the next segment is activated.
  - If a segment time > 999 min has to be programmed, this time must be split between several consecutive segments.

Program selection:

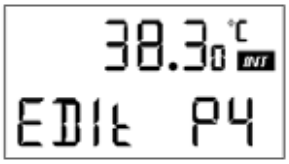


- Press key to enter Edit mode.



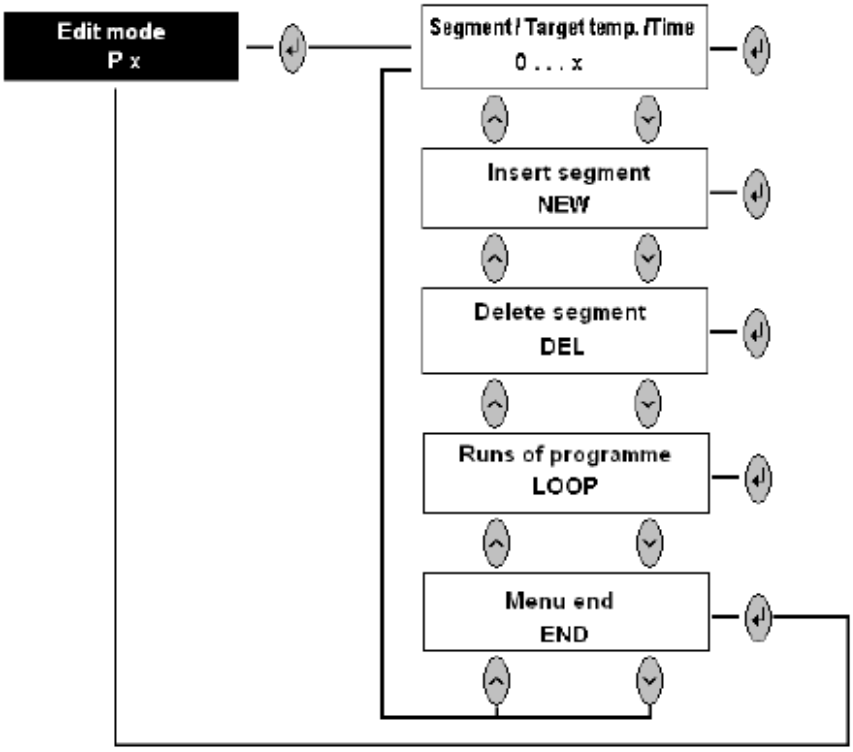
- The display shows the selection for programme 1 (P 1).

- Press the key to select P 2, P 3, P 4, P 5.



- Press key to enter.

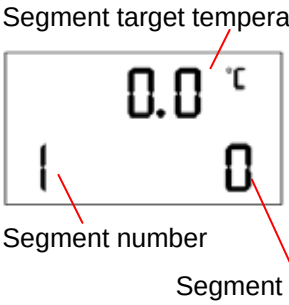
Input of a programme: (a Programming example 7.6.3.1)



- This display appears if the programme storage position is empty; i.e. no segment has been defined.

- Increments the number of segments by one each time until the required number of segments appears. In this example 6 segments.

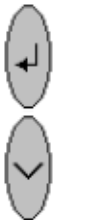
- Press several times until the display below appears. The segment indication runs backwards.



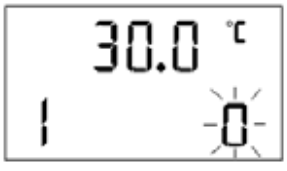
- Press key. Segment target temperature flashes with brief OFF period.

- Press again.
- Segment target temperature flashes in input mode (longer OFF time).

- Input the target temperature.



- Enter the value, or it is entered automatically after 4 sec.



- Segment time flashes with brief OFF period.

- Press to enter.

- Input the segment time 0 ... 999 min.

- Enter the value, or it is entered automatically as above.

- Click forward to end.

- Terminates input mode for segment 1.

- Click forward to segment 2. Further inputs as for segment 1 etc. until the final segment 6.

- Programme has been input completely.
  It is useful to check the contents of the programme store. To do this, press to segment 1 and with show all segment data consecutively on the display.

Display of a stored programme and alteration of the segment data:

- Start as described under Edit, programme selection, then scroll with through the segment data.

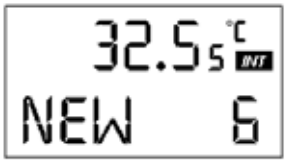
- With select Edit; the temperature value blinks briefly. Continue as for programme input.

Adding or inserting a new segment:

Both alterations increase the number of segments!

Adding:

- Extending a programme by new segments at the programme end.



- In the Edit submenu clock forward until the display shows NEW. The display shows the final segment number of the programme.

2x

- Press twice to add new segment number.

- Press key to go back to segment 7.

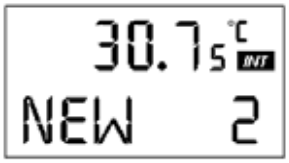
- Input segment data for segment 7 and data as described under input.

Inserting:

- Inserting new segments.

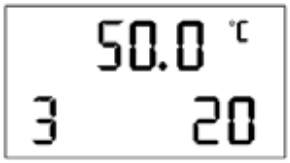
- For inserting one or more segments, proceed as described above.
  Example: After segment 2 it is requested to enter a further segment.

- Then using the key, select the segment after which a new segment has to be inserted.



- Press key to enter.

- It can be seen that the total number of segments has increased.



- Input data for new segment as described above.

Deleting a segment:

2x

Deleting the last segment:

- In the Edit submenu clock forward until the display shows DEL. The display shows the final segment number of the programme.
- Press key twice to delete the final segment.
- As protection against unintentional deletion, this function is performed only after confirmation of key .
- The display shows the new final segment number.

Deleting a particular segment:

e.g. **5x**

- To delete any particular programme segment, confirm this by pressing key .

- The display shows the new final segment number.

- The display shows DEL AII instead of DEL 0. This allows deletion of the entire programme.
- This operation is recommended before input of a new programme at a programme storage position which has already been used, before input of the segment number with NEW.

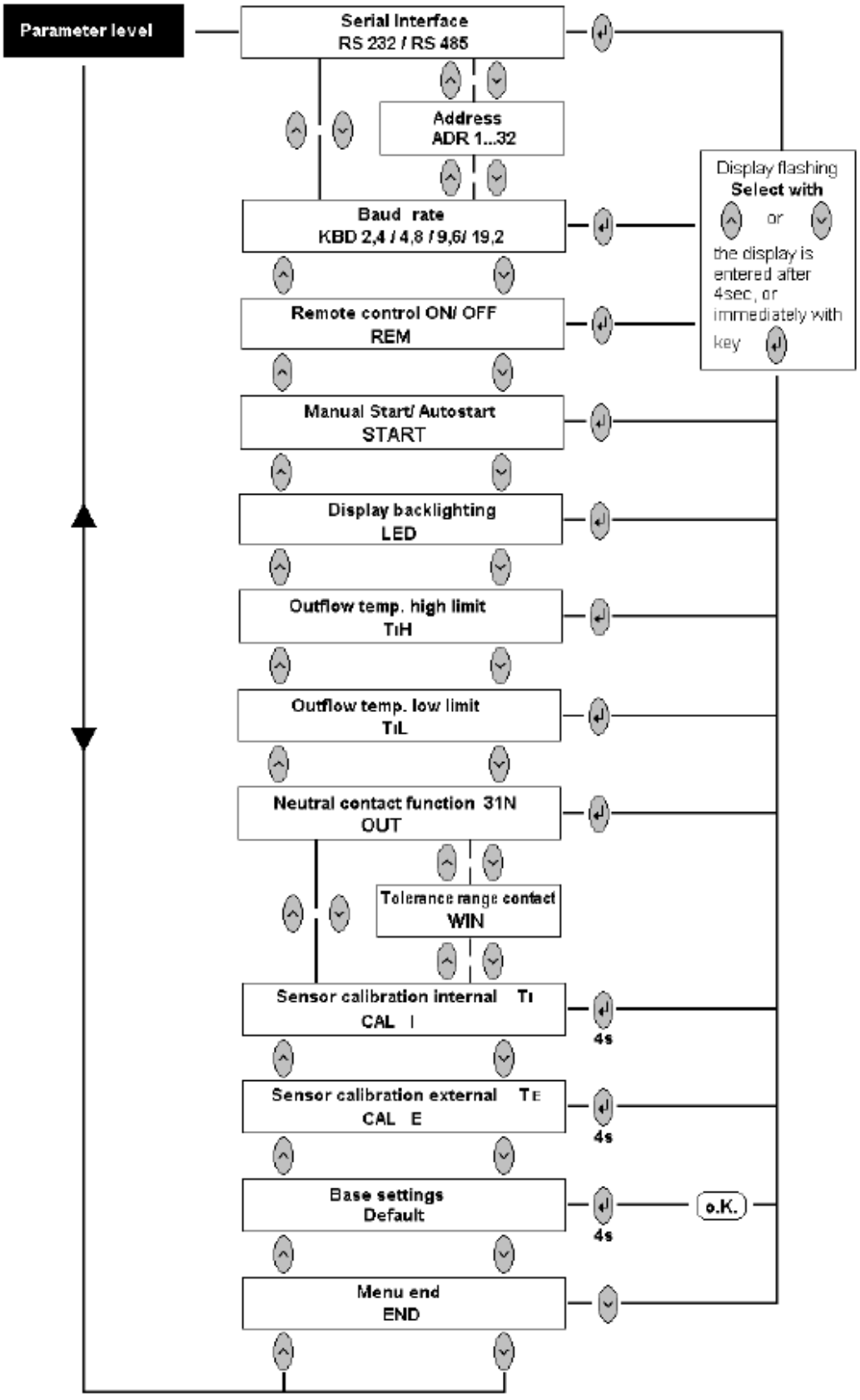
Input of the number of programme runs:

- In the Edit submenu, click until the display shows LOOP.

- Using the keys select the number of programme runs.

  Enter immediately with or the value is entered automatically after 4 sec.
  Up to 250 runs can be programmed. With input “0” to programme is repeated indefinitely until STOP.

7.6.4 Parameter level (PARA)



7.6.4.1 Serial interface parameters / Remote control

- Selection whether RS232 or RS485 is being set.

- On RS485 the device address has to be set from 1 to 32.

- On RS232 the display shows immediately the selection menu for baud rate. It can be set to 2.4/ 4.8/ 9.6/ 19.2

Remote control

- To activate the connected remote control set **"ON"**. Set to **"OFF"** without FBT.

- When communication between thermostat and FBT is interrupted there is a fault message and acoustic signal. This is also the case when the FBT is switched off.

Unit is switched off as is in case of fault.

- Release after the eliminating the cause of fault (only possible at the thermostat!).

7.6.4.2 Manual Start - Autostart

- Select "Manual Start“ or "Auto start“ when mains are **ON**.

0 = Manual Start
I = Auto start

- In case of "Auto start" the unit is started automatically as soon as mains are switched ON or in case of voltage failure as soon as voltage returns.

- In case of "Manual Start" the key has to be pressed each time the mains are switched ON or after mains failure and return.

7.6.4.3 Display backlighting

- The display backlighting can be switched off if necessary **(LED OFF)**.

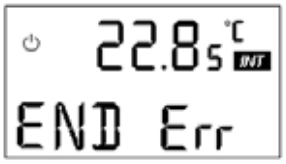
7.6.4.4 Outflow temperature limit

High limit (TiH)

- The temperature set here limits the outflow temperature. Especially with external control this limitation avoids the undesirable permanent switch-off through the safety circuit (overtemperature) during the start-up phase.

Low limit (TiL)

- The temperature set here limits the outflow temperature against excessively low values, e.g. in order to prevent freezing up.



- Input of a value for TiH which is below the value for TiL causes to appear “END Err” as error message at menu end.
- The values for TiH and TiL are entered only after leaving the submenu.

7.6.4.5 Neutral contact function

- OUT determines the function that is reported through the neutral contact.

0 = Overall fault (default setting) (a 7.6.4.8)
1 = Tolerance range monitoring (a 7.6.4.6).

7.6.4.6 Tolerance range contact

- With WIN (Window) a tolerance range can be chosen. Input range 0.2...20.0 °C. The input value corresponds to the half of the tolerance range. Comparisons are made between setpoint and controlled variable, at internal control with Ti, at external control with TE. If the difference is greater than the input value the neutral contact 31N switches.
  2, 1 closed = controlled value within window
  2, 3 closed = controlled value outside of window.

7.6.4.7 Sensor calibration (CAL)

+

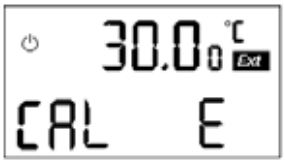
Calibration with key should only be activated if a sufficiently accurate temperature measurement device is available as reference.
The change causes the factory calibration to be lost.
Maximum calibration range ±3 °C. The calibration produces an additive shift over the entire measuring range.

Calibrating the internal Pt100 (outflow sensor)

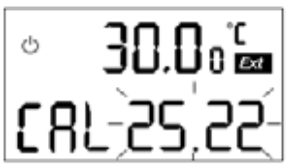
- Measure the outflow temperature with the reference probe at the pump outlet in the liquid stream.

- Press approx. 4 sec. Input the corrected value.

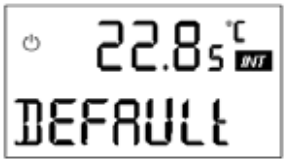
Calibrating the external Pt100 (external sensor)



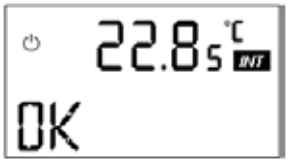
- Place the reference sensor at the location of the external Pt100. Press approx. 4 sec. Input the corrected value.
  If no external Pt100 is connected the display shows **FAIL**.



7.6.4.8 Base settings (DEFAULT)

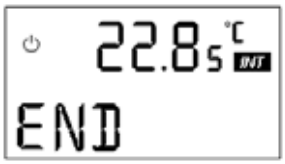


- Pressing the key approx. 4 sec programs certain essential functions to the factory settings. These include internal control with manual setpoint input, standard control parameters etc.



- The display shows **OK**.

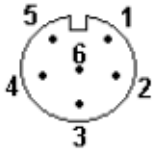
7.6.4.9 Menu end “Parameter“



- Leads to **PARA . .** at level 1.

7.6.5 Analogue interface level (ANA)

The equipment is provided with two standard analogue signal inputs and 3 outputs. Each input and output can be set to the standard signals 0 - 10 V, 0 - 20 mA or 4 - 20 mA. The signals are connected to a 6-pin plug (66S) according to NAMUR NE 28.



- View on socket (front) or plug solder face.

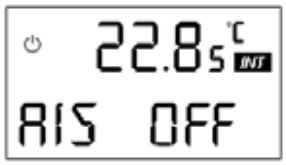
\+ Use screened cables. Connect screen to connector case!

Coupling connector 6-pin Cat. No. EQS 057.

-	Pin 1	Output 1
	Pin 2	Output 2
	Pin 3	0 V reference potential
	Pin 4	Setpoint input
	Pin 5	Output 3
	Pin 6	Input external actual temperature.

- The inputs are permanently assigned to the signals setpoint and external actual temperature. The outputs can be configured as required for outflow temperature Ti, external actual temperature TE, and setpoint S, pressure P and electrical output Y. The temperatures can be scaled in the range -100.0 to 400.0 °C. The pressure assignment is 0 to 10.0 bar, the electrical output -100 to 100 %.

- Pressing the key leads to the submenu “Analogue interface level”. All settings for the analogue inputs and outputs can be found there.

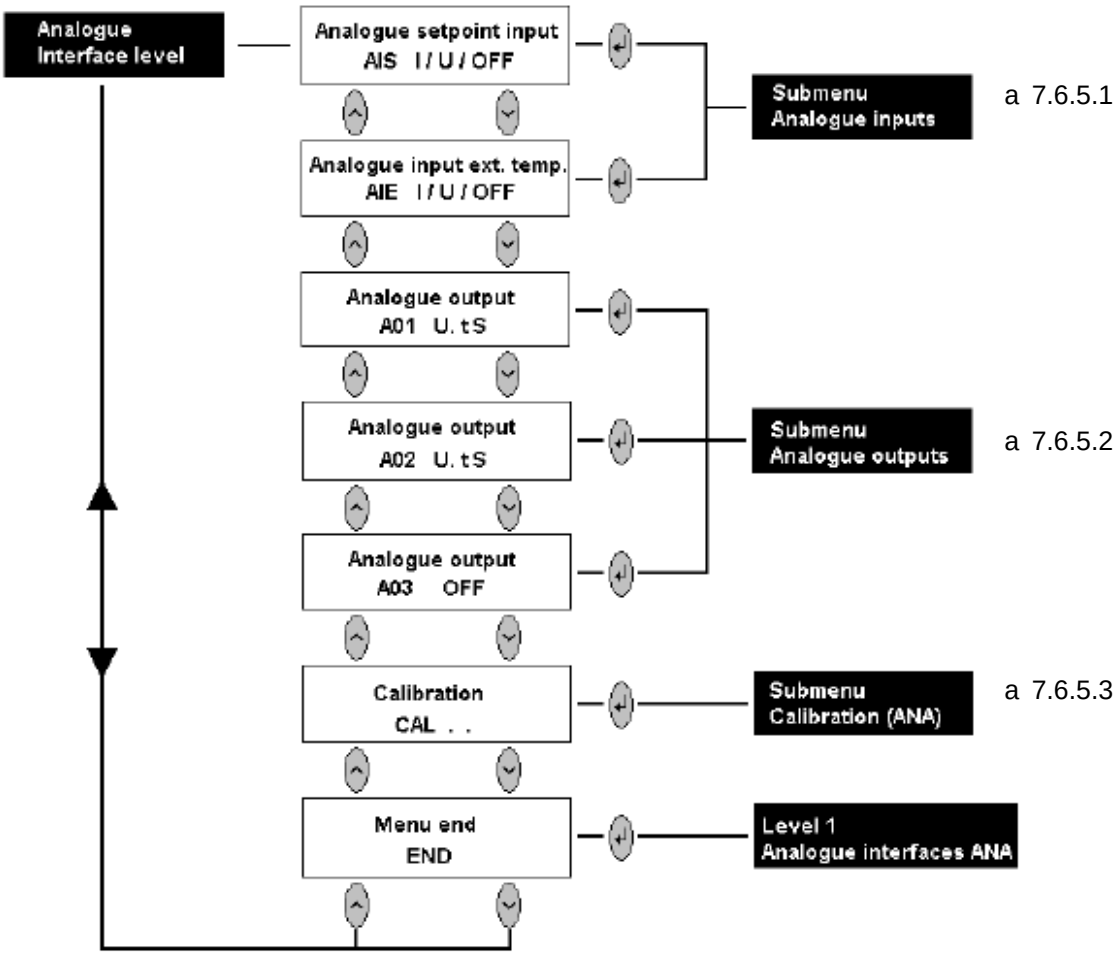


- Accuracy of the inputs and outputs after calibration is better than ± 0,1 % full scale
- Resolution of the outputs

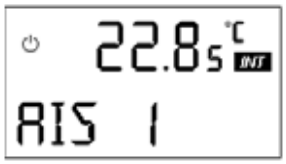
Temperature	< 0,01 % of the range however not < 0.01 °C
controller output Y	0.1 %
Pressure	0.1 bar

-

Current inputs	input impedance < 100 Ohm
Voltage inputs	input impedance > 50 kOhm
Current outputs	max. burden 400 Ohm
Voltage outputs	min. load 10 kOhm.


Analogue Interface level
Analogue setpoint input AIS I / U / OFF
Analogue input ext. temp. AIE I / U / OFF
Submenu Analogue inputs
a 7.6.5.1
Analogue output A01 U. tS
Analogue output A02 U. tS
Analogue output A03 OFF
Submenu Analogue outputs
a 7.6.5.2
Calibration CAL . .
Submenu Calibration (ANA)
a 7.6.5.3
Menu end END
Level 1 Analogue interfaces ANA

- AIS = analogue Input Setpoint
  OFF = setpoint input is switched off, i.e. manual value setting or value set via serial interface is active.

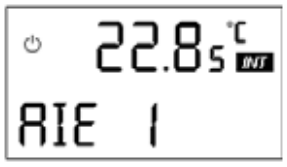


- Analogue setpoint input is switched on, with current input (I) configuration. With voltage the display shows AIS U.

- Scroll to AIE
  or

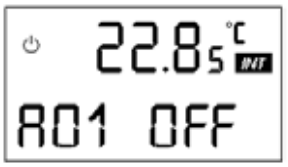
- pressing the key leads to submenu setpoint, “Analogue inputs” (a Section 7.6.5.1).

- AIE = analogue Input external actual temperature as standard signal/ instead of Pt100 on input 10S.
  OFF = this input is switched off, the measurement of the Pt100 at socket 10S is valid.

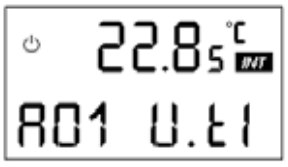


- Input is switched on. With current configuration (I). In case of voltage the display shows AIE U.

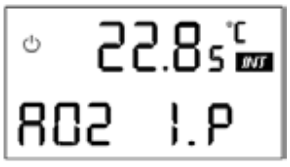
- Pressing the key leads to the submenu “analogue inputs” external actual temperature (a Section 7.6.5.1)
  or



- A01 = analogue output 1
- OFF = switched off.

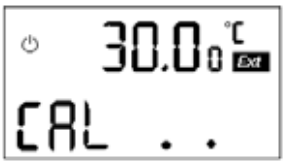


- Analogue output 1 is switched on. With voltage output (U) configured and the internal temperature signal, i.e. outflow temperature (t I).



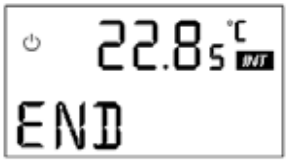
- I = current output
  tE = external actual temperature
  tS = setpoint
  P = pressure
  Y = electrical output
- Outputs 2 and 3 are similar to output 1.

- Pressing leads to the submenu “Analogue outputs”. (a Section 7.6.5.2).



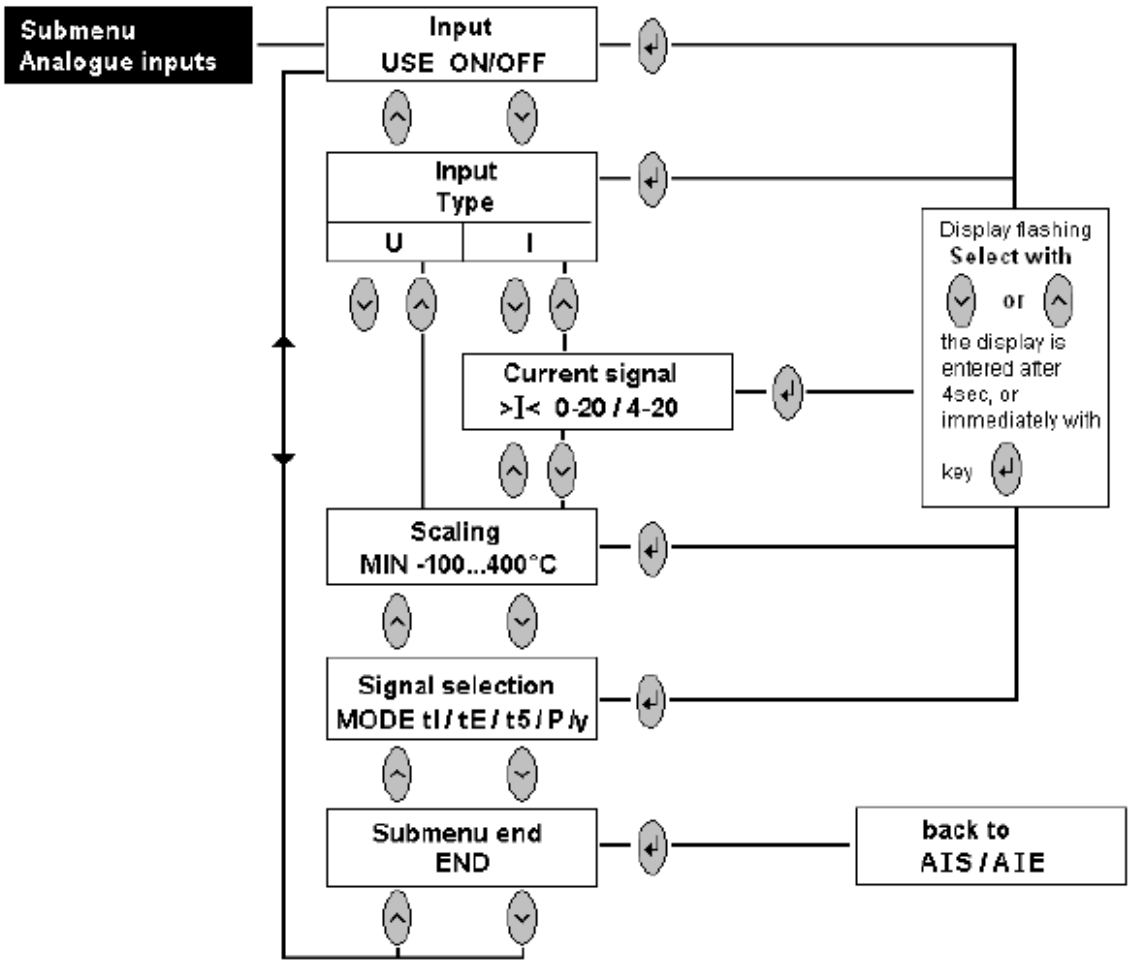
- CAL = calibration of inputs and outputs at 0 and 10 V or 0/ 4 and 20 mA.

Pressing leads to the submenu “Calibration”. (a Section 7.6.5.3).

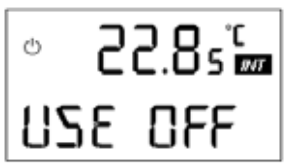


- Leads to ANA at level 1.

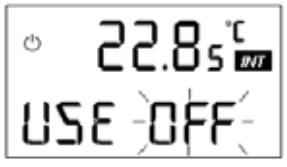
7.6.5.1 Submenu Analogue inputs



- From AIS scroll to



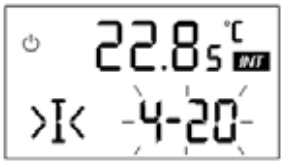
- USE = here the input setpoint can be switched (ON/OFF).



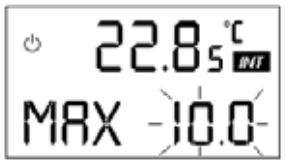
- Enter required status with .

- Type = input signal type; voltage 0-10 V (U) or current 0-20 mA (4- 20 mA) (I).

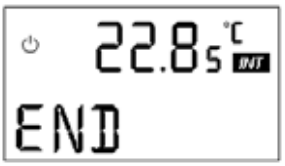
- If a current range has been selected there is also a request whether range 0-20 mA or range 4-20 mA is required.



- MIN = minimum temperature in °C
  For determining the temperature range to which the current or voltage range has to be assigned.

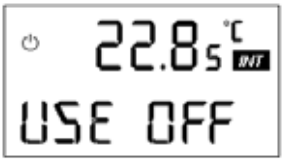


- MAX = maximum temperature in °C.
  For determining the temperature range to which the current or voltage range has to be assigned.
- Example: 0...10 V is to correspond to –50...150 °C MIN = -50; MAX = 150. At the setpoint input only values in the range –30 °C to 120 °C are processed since this corresponds to the operating range of the equipment. Outside this range the display shows the limit value.

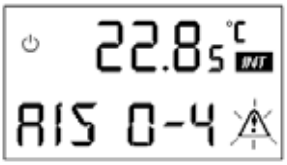


- Back to AIS.

- Scroll to submenu “Analogue inputs”, but referred to the configuration and scaling of the external temperature input (a Section 7.6.5.1).

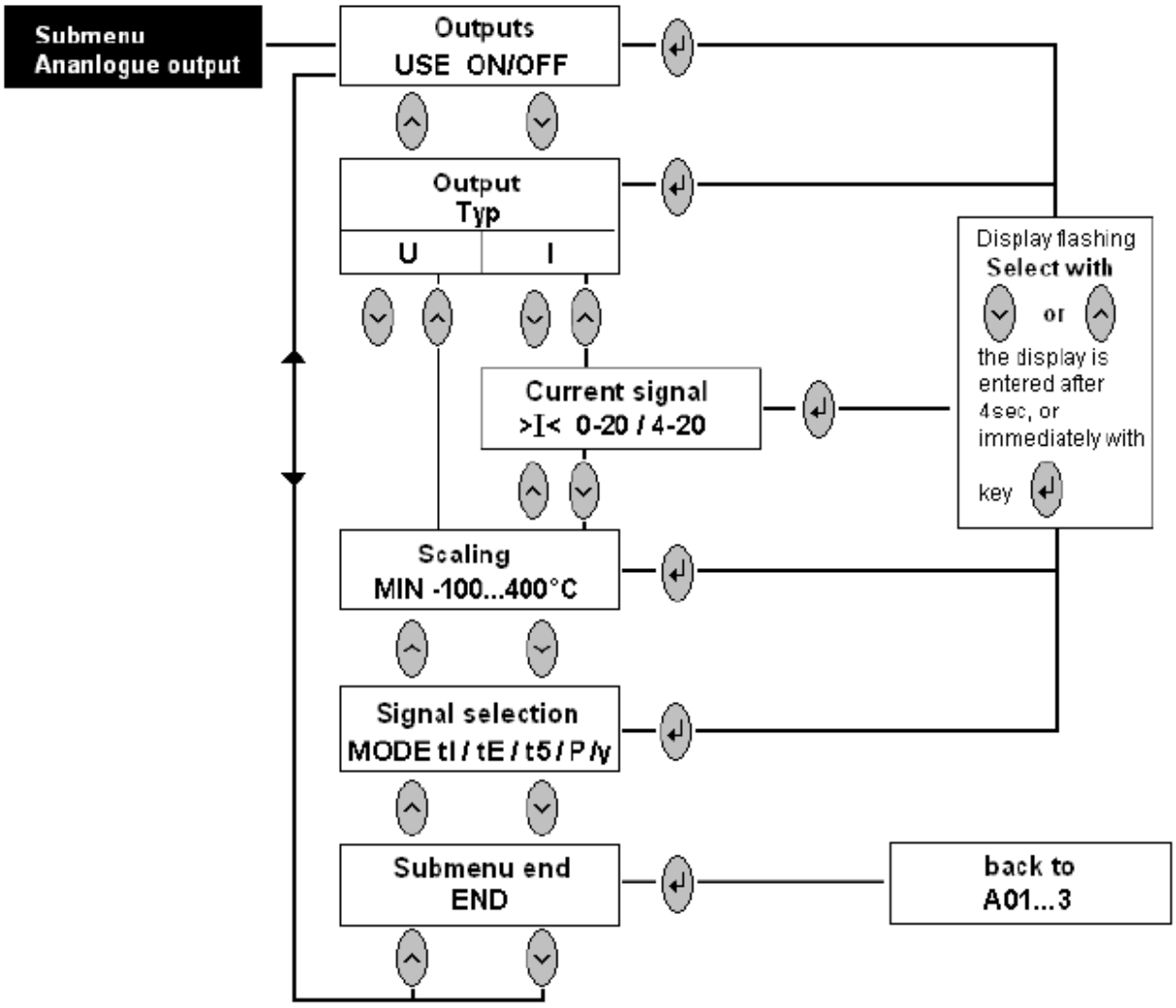


- Continue as for setpoint input AIS.

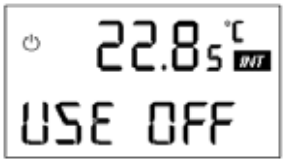


- **Error message**, in the current range 4 - 20 mA the current is less than 4 mA (0 to 4 mA).

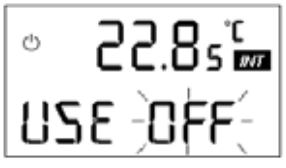
7.6.5.2 Submenu Analogue outputs



- From A01 scroll to

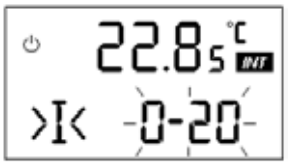


- USE = here the analogue output 1 (or, depending on previous steps, output 2 or output 3) can be switched ON and OFF.

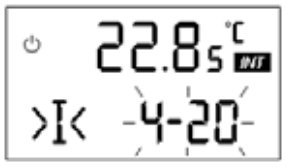


- Enter required status with .

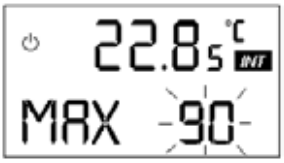
- Type = output signal type; Voltage 0...10 V (U) or Current 0...20 mA (4...20 mA) (I).



- If a current range has been selected there is also a request whether range 0 – 20 mA or range 4 – 20 mA is required.

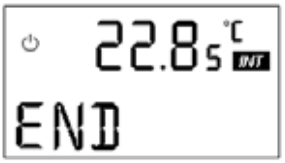


- MIN = minimum temperature in °C (or pressure or electrical output).
  For determining the temperature range to which the current or voltage range has to be assigned.



- MAX = maximum temperature in °C (pressure or electrical output).
  For determining the temperature range to which the current or voltage range has to be assigned.

- MODE = operating mode; assignment of signal source to output.
  t I = outflow temperature (Internal)
  t E = external actual temperature
  T S = setpoint
  P = pressure (at pump outlet) (0 - 7 bar)
  Y = electrical output (± 100 %).

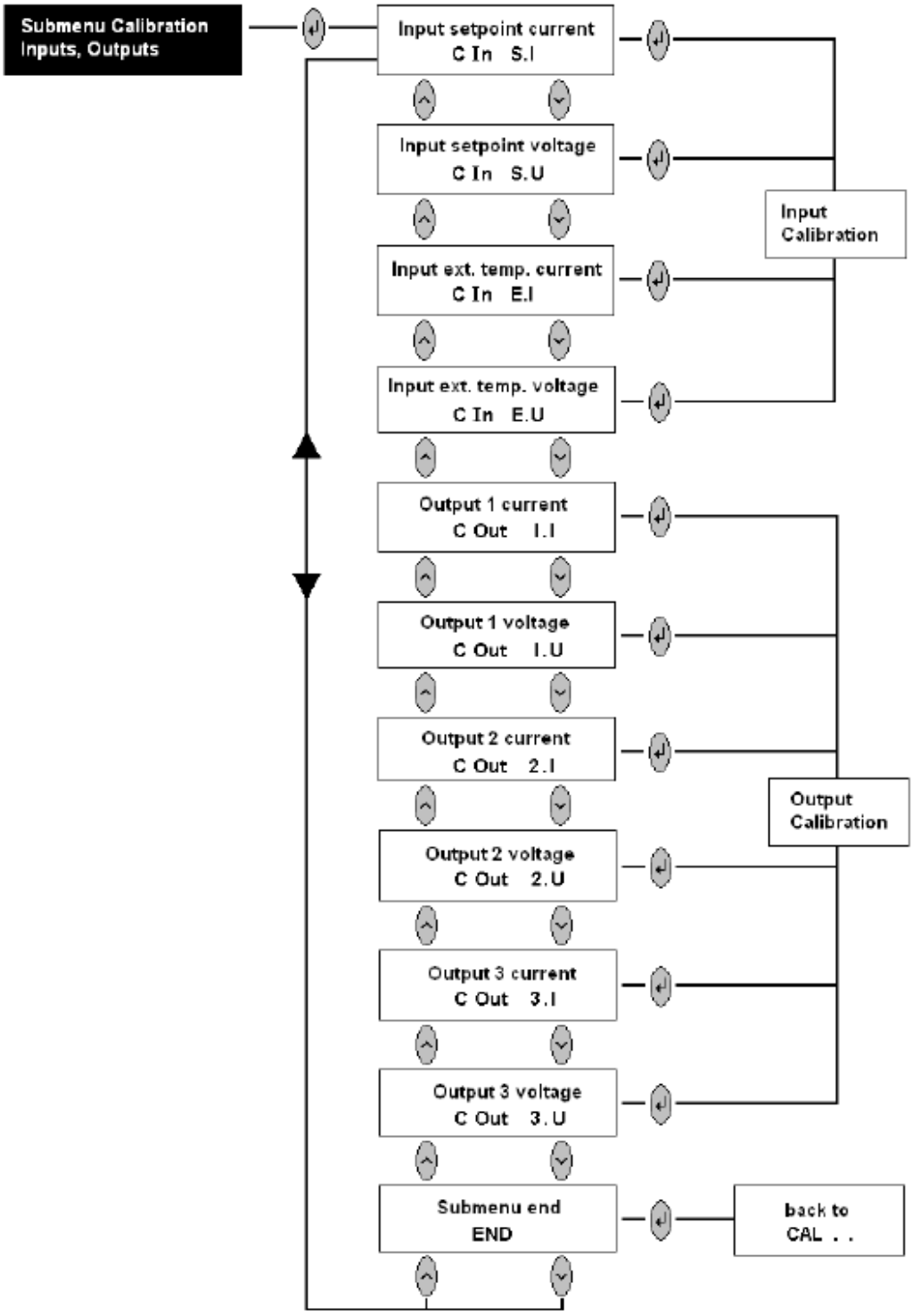


- Back to A01 or A02 or A03.

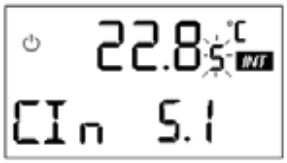
+ On changing from temperature range to pressure or electrical output or vice versa, recheck MIN, MAX!

7.6.5.3 Submenu Calibration (ANA)

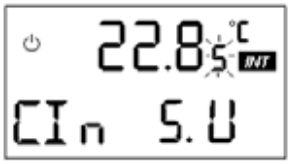
In order to avoid undesirable operating conditions only the selected channel is switched on during calibration. All others are switched off. After calibration has been completed the previous status (inputs/ outputs ON/ OFF) is restored.



- From **CAL . .** scroll to



- C In = calibrate (C);
  Input (In); S.I = setpoint; current signal (I).



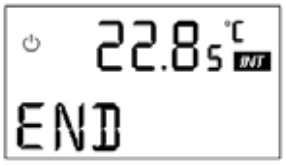
- S.U = setpoint; voltage signal (U).

- E E.I = external temperature input (E); current signal (I).

etc.

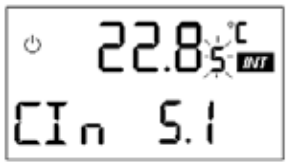
- Continue see ill. start 7.6.5.3.

- Out = analogue output 3 (Out 3); voltage signal.



- Scrolls to CAL in “Analogue interface” menu.

Calibrating the inputs



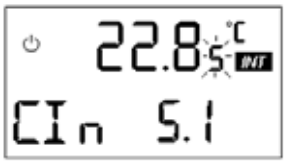
- Apply the voltage or current for the appropriate range limits (0 V, 10 V, 0 mA, 20 mA). Deviations up to approx. 10 % of range can be corrected.
- The calibration values remain stored!
- Factory calibration is performed at 0 V, 10 V, 0 mA and 20 mA.

- Feed in current 0 mA at pins 4 (+) and 3 (-) on connector 66S.

after approx. 2s

- Feed in current 20 mA.

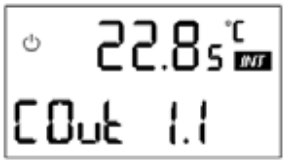
after approx. 2s



- Calibration of setpoint input current is completed.

- Setpoint input voltage and external temperature input current and voltage are calibrated similarly.

Calibrating the outputs



- Connect up the device to be supplied or an accurate multimetre with a current range 0 - 20 mA or a voltage range 0 - 10 V.
- Calibrate the outputs with the required termination resistance.

4s

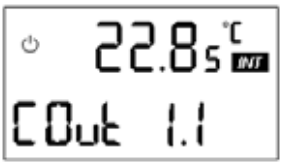
- after approx. 4 sec. the second point.

- Take current reading on the meter and set it with

e.g. 1300 = 1.3 mA.

- Take current reading on the meter and set it with

e.g. 1991 = 19.91 mA.



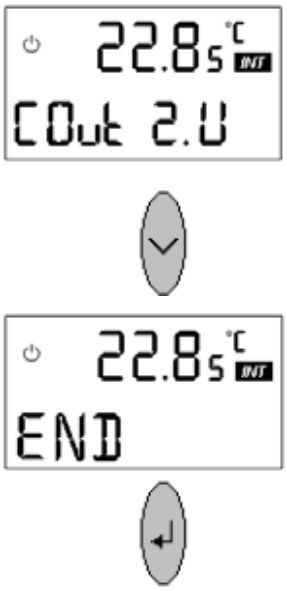
- After calibration has been completed this display appears again.

or with standard voltage signal 0 - 10 V.

4s

- after approx. 4 sec. the second point.

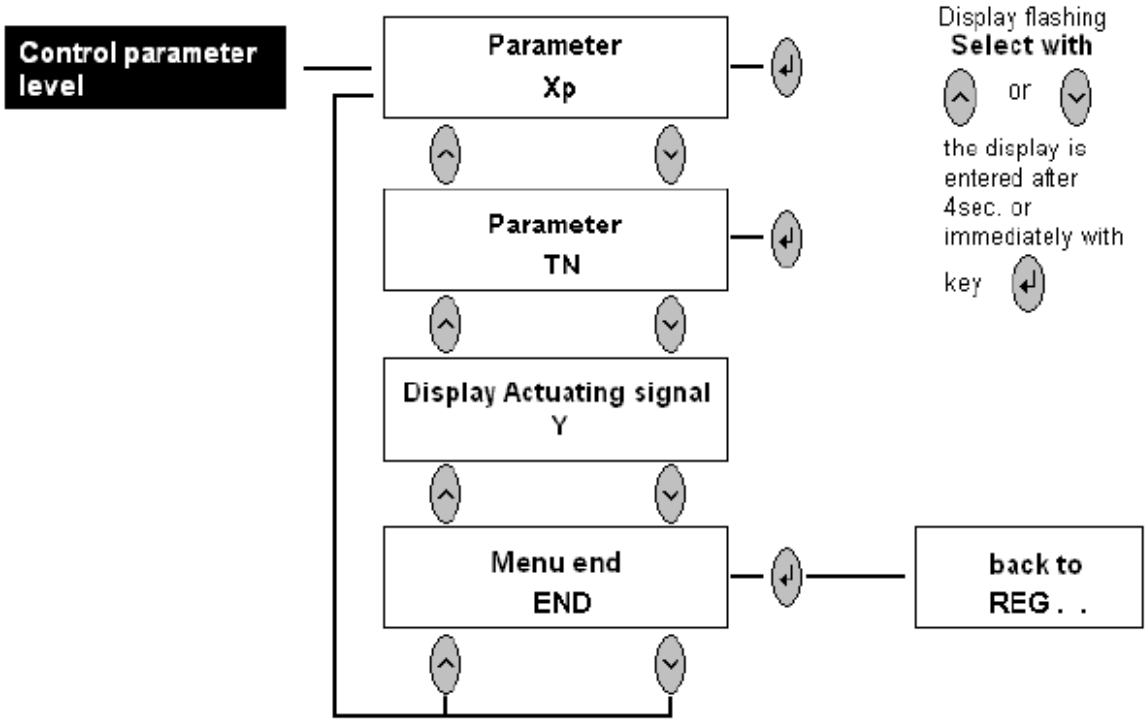
- Corresponding start values for voltage calibration are L 500 and H 9000 = 0.5 V and 9 V.



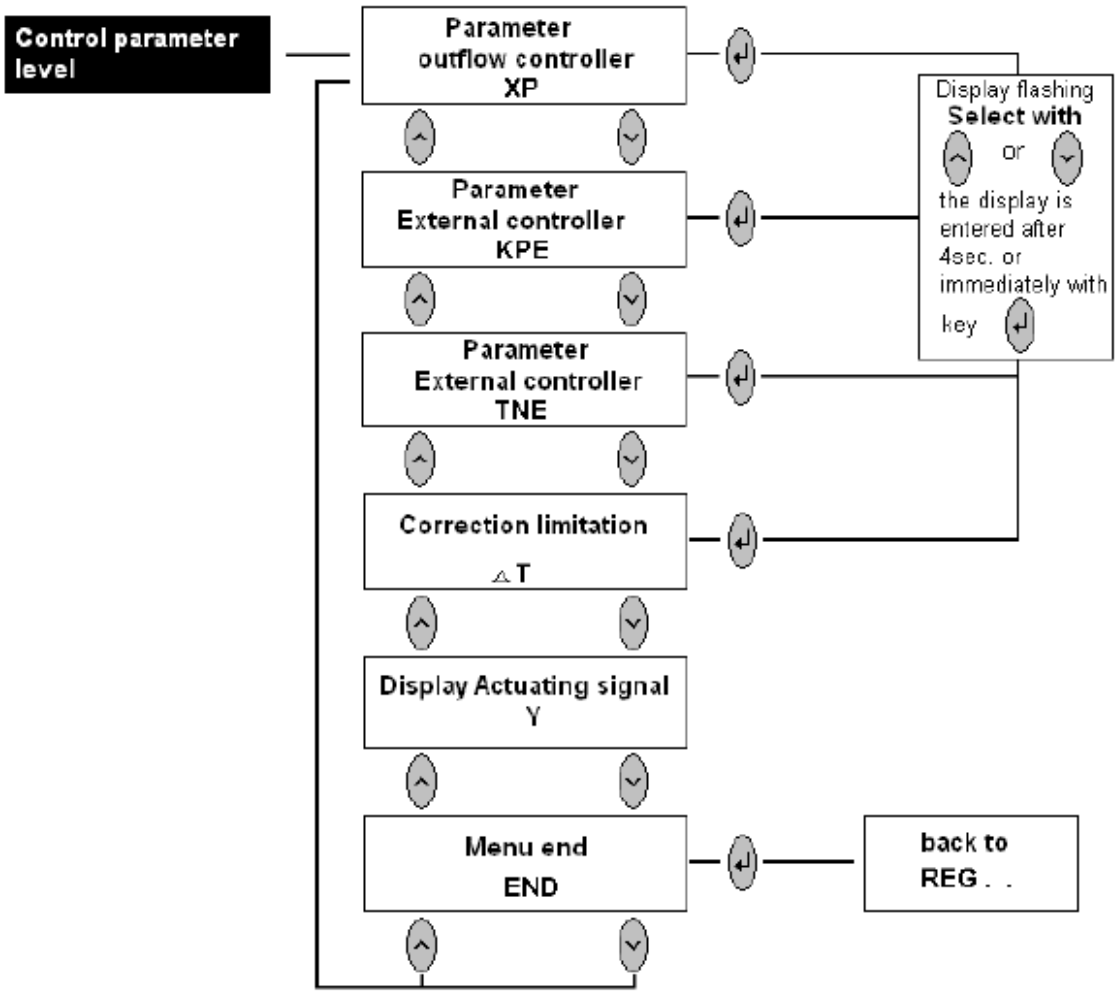
- After calibration has been completed this display appears again.
- Back to the menu "Analogue interface CAL".

7.6.6 Control parameter level

With internal control (outflow control):



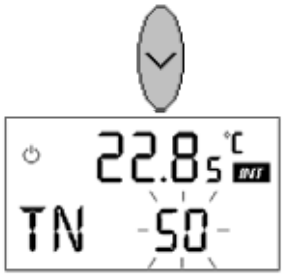
With external control switched on:



- Pressing scrolls from **REG . .** to the input for the control parameters.

With internal control (CON I)

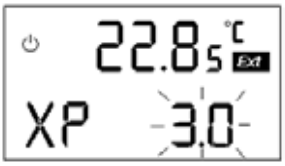
- With internal control (CON I) select here the proportional band Xp for the outflow controller. Input range 0.1 ... 10 °C. Useful values are 2 – 7 °C, depending on external circuit and heat transfer liquid. If the value is too small (e.g. 2 °C) this may result in control oscillations.
  If the value is too large (e.g. 8 °C) the compensation of disturbances may be worse and more sluggish.



- Select here the reset time TN for the outflow controller. Input range 1 - 200 sec. 200 is followed by OFF, i.e. the integral function of the controller is switched off, the controller operates as a proportional controller with permanent control offset. OFF is normally not used. Suitable values are 20 - 100 sec.
- Small values produce rapid control action but lead also to instability. Values around 50 sec usually give adequate results.

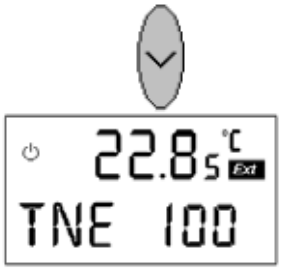
- The controller output can be indicated here, e. g. for use during servicing.

With external control (CON E) switched on:



- Proportional band Xp for outflow controller. When working with the external controller the outflow controller operates as proportional controller in the cascade circuit.
- The criteria are similar to internal control.

- Control gain of the master controller of the cascade. Larger values produce a faster reaction and possibly instability.
- Suggested value KPE = 3.0.



- Reset time TN of the master controller.
  KPE and TN depend largely on the conditions, i.e. volume, heat transfers, pump output and location of external controller.
- Suggested value for TN = 100sec.

+

- It is essential to ensure that there is optimal thermal coupling between heat transfer liquid and external sensing point. Otherwise satisfactory control can not be achieved. Under unfavourable conditions, simple outflow temperature control may give better results.

- Correction limitation:
  Here it is possible to set a limit for the difference between external temperature (TE) and the outflow temperature. This is used e.g. for gentle heating of the product being heated. It can also be helpful for a better stabilisation of the external temperature. 00 means that this function is de-activated. Values between 1 °C and 200 °C can be set.

7.7 Serial interfaces RS232, RS485

7.7.1 RS232 Interface

Connecting cables and interface test:

Computer					Thermostat		
Signal	9-pin sub-D socket		25-pin sub-D socket		9-pin sub-D socket		Signal
	•	,	•	,	•	,	
R x D	2	2	3	3	2	2	T x D
T x D	3	3	2	2	3	3	R x D
DTR	4		20		4		DSR
Signal Ground	5	5	7	7	5	5	Signal Ground
DSR	6		6		6		DTR
RTS	7		4		7	┌ 7	CTS
CTS	8		5		8	└ 8	RTS

- • with hardware handshake: for connecting a thermostat to the PC use 1:1 cable and not a null-modem cable!
- , without hardware handshake: the computer/ PC must be set to the operating mode “without hardware handshake”. Pins 7 and 8 on the thermostat connector must be connected together.

+

- Use screened connecting cable.
- Connect screen to connector case.
- The connections are isolated from the remainder of the electronics.
- Any pins not in use must not be connected!

When a PC is connected up the RS232 interface can easily be tested using the Microsoft Windows operating system. On Windows 3.11 with the “Terminal” program, on Windows® 95/ 98/ NT/ XP with the “Hyper Terminal” program.

"HyperTerminal" is no longer part of the operating system in Windows Vista, Windows 7 and Windows 8.

- With the LAUDA software "Wintherm Plus" (catalogue number LDSM2002) the RS232 interface can be addressed.
- In the internet there are terminal programs available as freeware. These programs offer similar functions as "HyperTerminal" (for example PuTTY).
  Search for „serial port terminal program”.

Protocol:

+

- The interface operates with 1 stop bit, no parity bit and 8 data bits.
- Transfer rate either 2400, 4800, 9600 (factory setting) or 19200 baud as selected.
- The RS232 interface can be operated with or without hardware handshake, (RTS/CTS).
- The command from the computer must be terminated with CR, CRLF, or LFCR.
- The response of the thermostat is always terminated with CRLF.

CR = Carriage Return (Hex: 0D)
LF = Line Feed (Hex: 0A)

Example: Transfer of setpoint 30.5 °C to the thermostat.

Computer	Thermostat
„OUT_SP_00_30.5“CRLF	ð
ï	„OK“CRLF

7.7.2 RS485 Interface

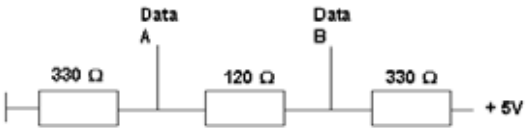
Connecting cable:

Thermostat	
9-pin sub-D socket	
Pin	Data
1	Data A (-)
5	SG (Signal Ground) optional
6	Data B (+)

+

- Use screened connecting cables.
- Connect screen to connector case.
- The connections are isolated from the remainder of the electronics.
- Any pins not in use must not be connected!

An RS485 bus always requires bus termination in the form of a termination network which ensures a defined rest status in the high-resistance phases of bus operation. The bus termination is as follows:



This termination network is usually incorporated on the PC plug-in card (RS485).

Protocol:

+

- The interface operates with 1 stop bit, no parity bit and 8 data bits.
- Transfer rate either 2400, 4800, 9600 (Factory setting) or 19200 baud as selected.
- The RS485 commands are always preceded by the device address. There is provision for 127 addresses. The address must always have 3 digits. (A000_...to A127_...).
- The command from the computer must be terminated with CR.
- The response of the thermostat is always terminated with CR.

CR = Carriage Return (Hex: 0D).

Example: Transfer of setpoint 30.5 °C to the thermostat with address 15.

Computer	Thermostat
„A015_OUT_SP_00_30.5“CR	ð
ï	„A015_OK“CR

7.7.3 Write commands (data commands to the thermostat)

Command	Explanation
OUT_SP_00_XXX.XX	Setpoint transfer with max. 3 digits before decimal point and max. 2 decimal digits behind.
OUT_SP_04_XXX.XX	TiH outflow temperature high limit.
OUT_SP_05_XXX.XX	TiL outflow temperature low limit.
OUT_PAR_00_XXX.XX	Setting of control parameter Xp for controller (0.1...10 °C).
OUT_PAR_01_XXX	Setting of the control parameter Tn (5...200 s).
OUT_PAR_04_XXX.XX	Setting of control parameter KPE (0.1...10.0).
OUT_PAR_05_XXX	Setting of control parameter TNE (5...200 s).
OUT_PAR_08_XXX.XX	Setting of the WIN value for tolerance range monitoring.
OUT_MODE_00_X	Keys: 0 = free / 1 = inhibited (corresponds to “KEY”).
OUT_MODE_01_X	Control: 0=internal / 1 = external.
START	To switch on the unit (standby modus or "Manual Start" ON if mains are OFF). When standby function is on auto (A) there is an error message (ERR35).
STOP	Switches thermostat to standby (pump, heating, refrigeration unit off). When standby function is on auto (A) there is an error message (ERR35).
RMP_SELECT_X	Selection of the programme (1-5) to which the further instructions apply. When the unit is switched on, programme 5 is selected automatically.
RMP_START	Start the programmer.
RMP_PAUSE	Hold (pause) the programmer.
RMP_CONT	Restart the programmer after pause.
RMP_STOP	Terminate the programmer.
RMP_RESET	Delete the programmer.
RMP_OUT_00_XXX.XX_XXX	Set a programme segment (temperature and time). A segment is added and appropriate values are applied to it.
RMP_OUT_02_XXX	Number of times the programme runs: 0 = unlimited / 1...250.

+

- For "_" use also " " (blank character).
- Response from thermostat "OK" or in case of error "ERR_X" (RS485 interface e.g.. "A015_OK" or in case of error "A015_ERR_X".).
- In different dates for one parameter (except for set point) are continuously transmitted to the thermostat due to bugs, this can lead to the destruction of the storage location in the thermostat. The storage locations can be overwritten up to 100.000 times.

Permitted data formats:

-XXX.XX	-XXX.X	-XXX.	-XXX	XXX.XX	XXX.X	XXX.	XXX
-XX.XX	-XX.X	-XX.	-XX	XX.XX	XX.X	XX.	XX
-X.XX	-X.X	-X.	-X	X.XX	X.X	X.	X
-.XX	-.X	.XX	.X				

7.7.4 Read commands (data requested from the thermostat)

Command	Explanation
IN_PV_00	Read bath temperature (outflow temperature).
IN_PV_01	Read external temperature TE.
IN_PV_02	Read pump pressure in bar.
IN_SP_00	Read temperature setpoint.
IN_SP_03	Read current overtemperature switch-off point.
IN_SP_04	Read current outflow temperature limit TiH.
IN_SP_05	Read current outflow temperature limit TiL.
IN_PAR_00	Read current value of Xp.
IN_PAR_01	Read current value of Tn (201 = OFF).
IN_PAR_04	Read current value of KPE.
IN_PAR_05	Read current value of TNE (201 = OFF).
IN_PAR_08	Read current value of WIN for tolerance range monitoring.
IN_DO_01	State of the neutral contact: 0 = make-contact open/ 1 = make-contact closed.
IN_MODE_00	Keys: 0 = free / 1 = inhibited.
IN_MODE_01	Control: 0 = internal / 1 = external.
IN_MODE_02	Standby: 0 = Unit ON / 1 = Unit OFF; and in case of the activated function "manual start" during the display "STArt/ 2 = auto.
TYPE	Read equipment type.
VERSION	Read software type.
STATUS	Read equipment status 0 = OK, -1 = error.

STAT	Read error diagnosis response: XXXXXXX à X = 0 no error, X = 1, 2, 3 error. 1. Char. = error (Exx). 2. Char. = pump error 0 = OK / 1 = pump 1 / 2 = pump 2 / 3 = both pumps error. 3. Char. = low level error. 4. Char. = overtemperature error. 5. Refrigeration unit error (e.g. pressure switch = PRES). 6. Char. = no external temp. probe (TE FAIL). 7. Char. = error analogue inputs 0 = OK / 1 = current analogue setpoint input < 4 mA / 2 = current analogue actual temp. input < 4 mA / 3 = both current inputs < 4 mA.
RMP_IN_00_XXX	Read a programme segment XXX (response: e. g. 030.00_010.00 = 30.00 °C and 10 min).
RMP_IN_01	Read the current segment number.
RMP_IN_02	Read the set number of programme runs.
RMP_IN_03	Read the current programme run.
RMP_IN_04	Read the programme to which further instructions apply.
RMP_IN_05	Read which programme is running now (0=none).

- For "_" use also " " (blank character).

+ - The equipment response is always in the fixed decimal format "XXX.XX" or for negative values "-XXX.XX" or "ERR_X". (RS485 interface e.g.. "A015_ XXX.XX" or "A015_-XXX.XX" or "A015_ERR_X").

7.7.5 Error messages

Message	Explanation
ERR_2	Wrong input (e.g. buffer overflow).
ERR_3	Wrong command.
ERR_5	Syntax error in value.
ERR_6	Illegal value.
ERR_8	Channel (ext. temperature) not available.
ERR_30	Programmer, all segments occupied.
ERR_31	Setpoint not possible, analogue setpoint input ON.
ERR_32	TiH £ TiL.
ERR_33	No external sensor.
ERR_34	Current below 4 mA.
ERR_35	Auto is selected.
ERR_36	No setpoint input possible. Programmer is running or is paused.
ERR_37	No start from programmer possible, analogue setpoint input is switched on.
ERR_50	Communication between thermostat and remote control FBT is interrupted.

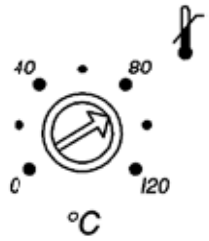
7.7.6 Driver software for LABVIEW®

An individual, easy-to-use control and automation software for operating the ECO, ECOLINE, INTEGRAL XT, INTEGRAL T and WK/WKL units can be programmed with the aid of the National Instruments program development tool LABVIEW®
(http://sine.ni.com/apps/we/nioc.vp?cid=1381&lang=US).
In order to make program operation possible on the RS232/ RS485 interface, LAUDA provides drivers specially designed for LABVIEW® which can be downloaded free of charge under www.lauda.de.

7.8 Warning and safety functions

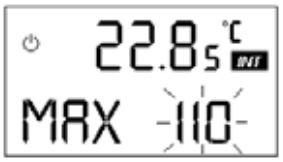
7.8.1 Overtemperature protection and testing

+ - The units are designed for operation with non-flammable and flammable liquids to EN 61010-2-010.



- Set the overtemperature switch-off point. Recommended setting 5 °C above the setpoint.

+ Not higher than 25 °C below the flame point of the heat transfer liquid used (a Section 6.4).



- The actual switch-off point is indicated on the display, e.g. max. 110 °C.
- Adjustment range is 0 – 125 °C.
- When operating with external control, set TiH (or 150 °C for Option 1 (a Section 7.6.4.4)) approx. 5 °C below the overtemperature switch-off point!

+ - When the potentiometer is being adjusted by more than 2 °C à display shows (for approx. 4 sec) MAX and actual overtemperature switch-off point with 1 °C resolution.
- The potentiometer setting is the effective function. The display only assists in making the adjustment.
- Setting possible only up to the upper limit of the operating temperature range + 5 °C.

%»

- When the outflow temperature rises above the overtemperature switch-off point:

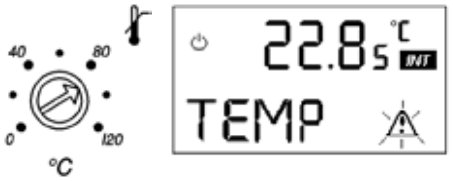
1. a double signal tone sounds.
2. The display shows TEMP for overtemperature, the fault triangle is flashing.
   à Heating is switched off on both poles,
   à Pump and refrigeration system are switched off.

- Rectify the cause of the fault.
- Wait until the outflow temperature has cooled down below the switch-off point or set the switch-off point higher than the outflow temperature. When the indication TEMP appears on the display, then

- Reset with the key.

+ - Before the equipment is run unattended for longer periods the overtemperature protection should be tested.

- Turn the potentiometer slowly anticlockwise
  à the equipment must switch off at the outflow temperature (INT).



- Steps 1 - 2 (see above) must follow.
- Then set the overtemperature switch-off point again above the bath temperature and wait until the indication TEMP appears on the display, then

- reset with the key.

7.8.2 Low-level protection and testing

%»

- If the liquid level falls below the minimum level, a double signal tone sounds.

1. The display LEVEL (low level) appears and the fault triangle is flashing.
   à Heating is switched off on both poles.
   à Pump and refrigeration system are switched off.

2. Top up the bath, (a Section 6.2), and reset with the key.

+

- Testing at regular intervals by lowering the bath level. Slowly drain the heat transfer liquid through the drain cock.
- Steps 1 - 2 must follow.

- Bath temperature during this test not below 0 °C or 50 °C max., otherwise danger of burn injuries!
- If there is any irregularity when testing the safety devices, switch off the equipment immediately and pull out the mains plug!
- Have the equipment checked by **LAUDA Service Constant Temperature Equipment**!

7.8.3 Pump motor monitoring

- In case of pump motor overload or a blockage, the heating, the pump and the refrigeration system are switched off.

- A double signal tone sounds.

- The display PUMP 1 appears and the fault triangle is flashing.
- Rectify the fault, e.g. clean the pump or check the viscosity, **then**
- if necessary allow the equipment to cool down approx. 30 min.

- reset with the key.
  WARNING! Equipment and pump start up!
- If several faults appear simultaneously, they have to be reset individually.
- In case of overload of the pump for the external circuit the message PUMP 1 is displayed on model T 4600 W.
- On units with a separate pump for internal circulation (T 4600 - T 10000 W) the message PUMP 2 means that the fuse F5 has to be replaced.
  Only by a qualified electrician: remove the side panel on the right.
- On units with a 3-phase pump (T 7000 - T 10000 W) the message PUMP 1 means that the motor protection cut-out has to be reset.
  Only by a qualified electrician: remove the side panel on the right.

7.8.4 Refrigerant pressure

- The compressor is switched off if the refrigerant pressure is excessive.
- This message is displayed:

- A double signal tone sounds.
- The refrigeration compressor starts up automatically!

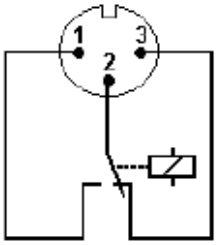
- Reset the fault message PRES.

7.8.5 Floating contact connection "Combination fault" 12N (Alarm out)

This function is only available if in the parameter menu OUT is set to 0 (a Section 7.6.4.4).

3-pin flange connector to NAMUR recommendation NE 28.

- 1 = n.o. (make).
- 2 = common.
- 3 = n.c. (break).
- When the unit is OK, 1-2 closed.



- View on flange plug (front) or coupling socket solder face.
- Max. 30 V; 0.2 A.

+ Use screened connecting cables. Connect the screen to the plug case. Cover unused connectors with protection caps!

Coupling socket Cat. No. EQD 047.

+
- The contact switches in case of a fault on overtemperature protection, low-level protection, pump motor monitoring or if there is some other error message.

7.8.6 Other error messages

- After rectifying the fault, reset with the key.

Multiple error messages are indicated as follows:

Error codes are shown sequentially using the keys and .

Message	Explanation
03	Can not write to data memory.
04	Data memory contains data errors.
05	Break or short-circuit of temperature sensor.
06	Temperature measurement circuit does not respond.
07	Measurement circuit for analogue inputs does not respond.
08	Message from control system: temperatures of safety and control systems not identical.
09	Message from safety system: temperatures of safety and control systems not identical.
10	No communication between safety and control systems.
11	Program error safety system.
12	Break of safety temperature sensor.
13	Program error control system.
14	Data error control system.
15	System error control system.

8 Maintenance

8.1 Cleaning

Before cleaning the equipment, pull out the mains plug!

The equipment can be cleaned with water with the addition of a few drops of a detergent (washing-up liquid), using a moist cloth.

Water must not enter the control unit!

+

- Carry out appropriate de-contamination if dangerous material has been spilled on or inside the unit.
- Method of cleaning and de-contamination are decided by the special knowledge of the user. In case of doubt contact the manufacturer.

8.2 Maintenance and repair

- Before any maintenance and repair work, pull out the mains plug!
- Repairs on the control unit must only be carried out by properly qualified electricians!
- Please take into consideration the prescriptions for operational safety (Betriebssicherheitsverordnung – BetrSichV), the rules for prevention of accidents “Refrigerating Plants, Heating Pumps and Cooling Systems” (Unfallverhütungsvorschriften BGV D4) as well as “Electrical Installations and Operating Material” (BGV A2)!

LAUDA process thermostats are largely maintenance-free. If the heat transfer liquid becomes dirty it has to be replaced.

8.3 Servicing intervals

System part	Mandatory for initial operation and before any longer unsupervised operation, then with recommended frequency	Chapter	Comment
Complete device			
External condition of the device	Monthly		
Heat transfer liquid			
Analysis of heat transfer liquid	Half-yearly (and as required)	(a 8.4)	
Heat transfer system			
Sealing	Daily		External visual inspection
External hoses			
Material fatigue	Monthly		External visual inspection
Cooling unit			
Cleaning of air-cooled condenser	Monthly	(a 8.6.1)	Air-cooled thermostat
Cleaning the dirt trap	Monthly	(a 8.6.2)	Water-cooled thermostat
Decalcifying the water cooling circuit	Quarterly	(a 8.6.2)	Water-cooled thermostat
Leakage tightness test	at least annually		at T 10000 (W), 97/23/EC (PED)
Electronics			
Overtemperature protection	Quarterly	(a 7.8.1)	
Low level alarm / warning	Quarterly	(a 7.8.2)	

8.4 Inspecting the heat transfer liquid

If the heat transfer liquid becomes contaminated or degenerated, it should be renewed.

If required, the heat transfer liquid should be checked for fitness for use (e.g. when changing the method of operation), or at least half-yearly. Further use of the heat transfer liquid is only permissible if the inspection indicates this.

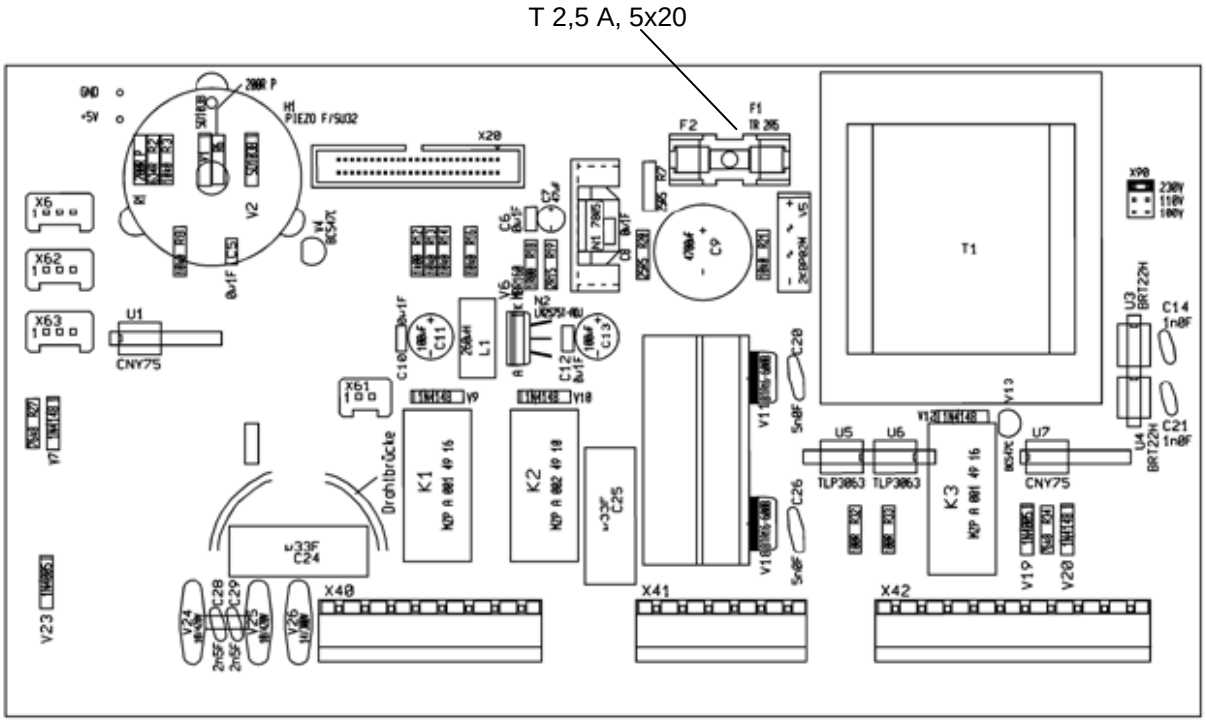
The test of the heat transfer liquid takes place according to DIN 51529; ("Testing and assessment of used heat carrier media"). Source: VDI 3033; DIN 51529.

8.5 Protective cut-outs and fuses

Single-phase units are protected against excessive current by an over current cut-out built into the mains switch. This switches off the power in case of a fault. Resetting as for switching on. If it cuts out repeatedly, contact the service organisation.

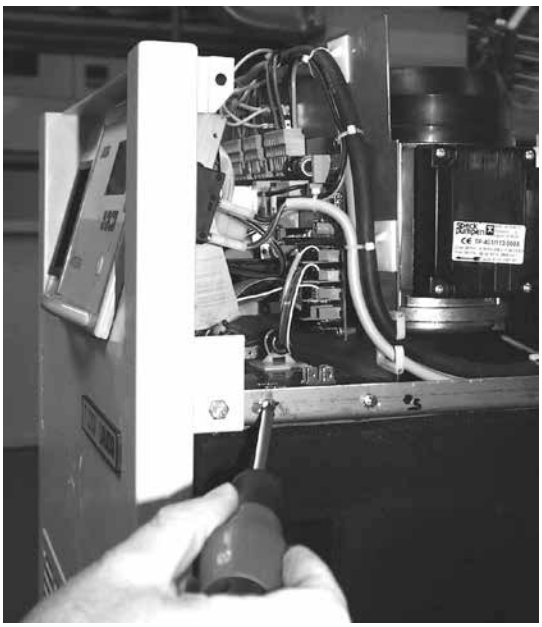
3-phase units are fitted internally with overload cut-outs. These are accessible after removing the side panels and possibly the cover.
Warning: Only by a qualified electrician!

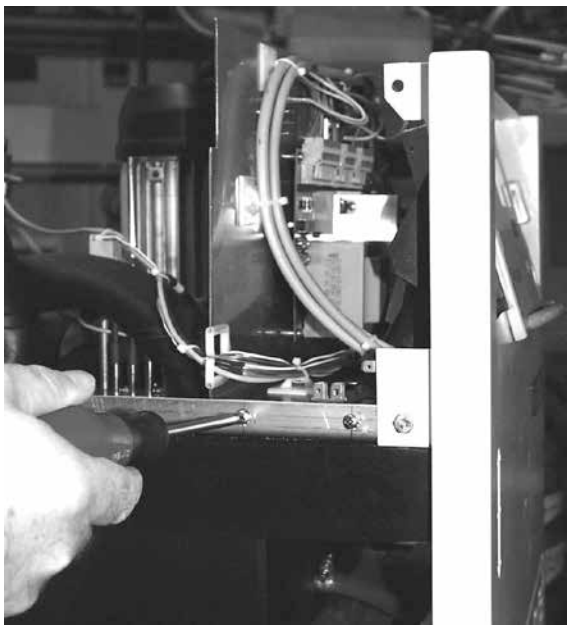
If it cuts out repeatedly after reset, contact the service organisation (a Section 8.8).



UL 514-A/B

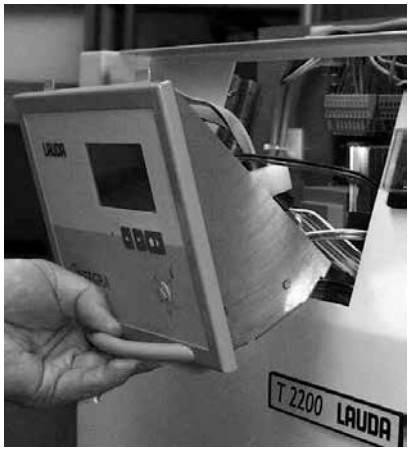
Circuit board UL 514-A/B (power supply) carries an instrument fuse T 2,5 A; 5x20. Cat. No. EEF 025. This is accessible after opening up the unit. The panels to the left and right of the electrical section may have to be removed.



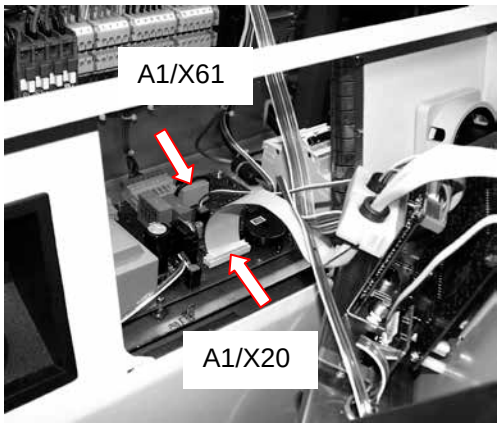


8.5.1 Dismantling the control unit

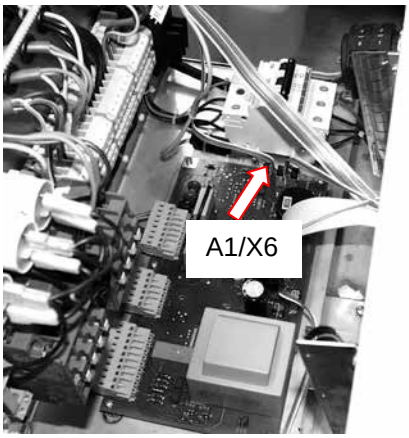
Turn the screw for the locking tab anticlockwise up to the stop. Swing out the control unit and pull it out downwards.



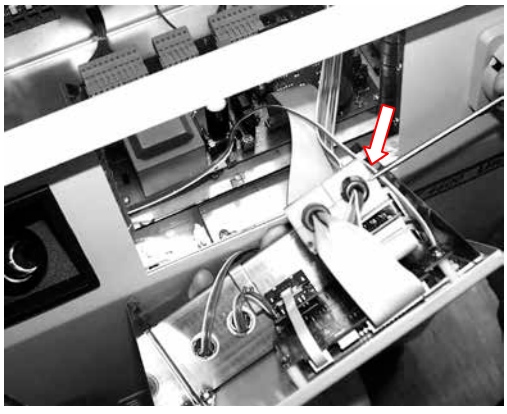
Carefully disconnect the connectors!



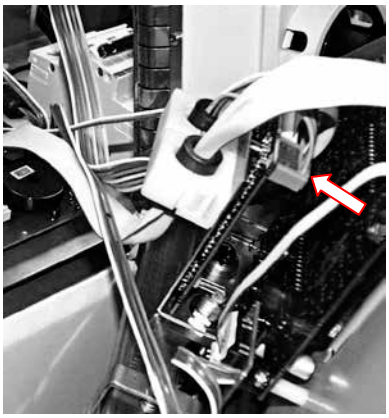
Disconnect connector A1/X61 and A1/X20.



Disconnect connector A1/X6.



Unlock with screwdriver and remove the mounting.



A3/X5

Disconnect the connector A3/X5.

8.6 Maintenance of the refrigeration unit

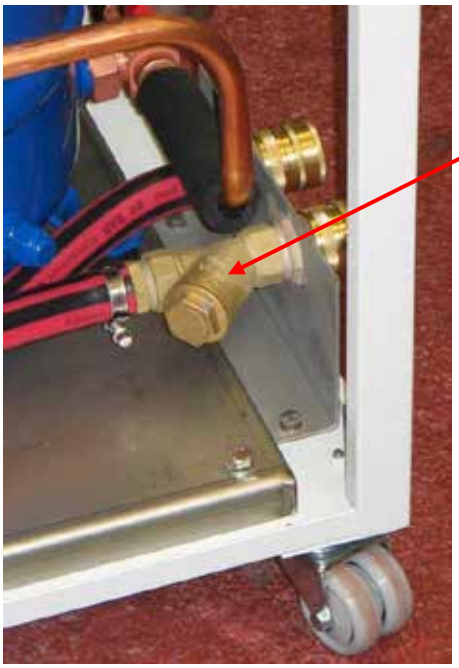
8.6.1 Air-cooled condenser

The refrigeration unit is largely maintenance-free. If the equipment is operating in a dusty atmosphere the condenser of the refrigeration unit has to be cleaned every 4 to 6 months or more frequently. This can be done in a most suitable way by screwing off the ventilation grid, then cleaning the condenser with a vacuum cleaner (using the brush top).

8.6.2 Water-cooled condenser

Cleaning the dirt trap:

At regular intervals of one month or longer the dirt trap must be cleaned, depending on the degree of soiling.



Unscrew the panel at the right side. Open the filter housing with an open-ended wrench (AF 19 or AF 27). Clean the filter and insert it again into the cooling water feed. Replace the panel.

Transport and storage:

Warning: if there is any danger of freezing (e.g. transport in winter) empty the condenser on water-cooled units! Heat the bath to approx. 20 °C. Disconnect the water hose from the water tap. Adjust the setpoint to e.g. 0 °C and, immediately after the compressor starts up, blow compressed air into the water supply hose (from the back: on the left).

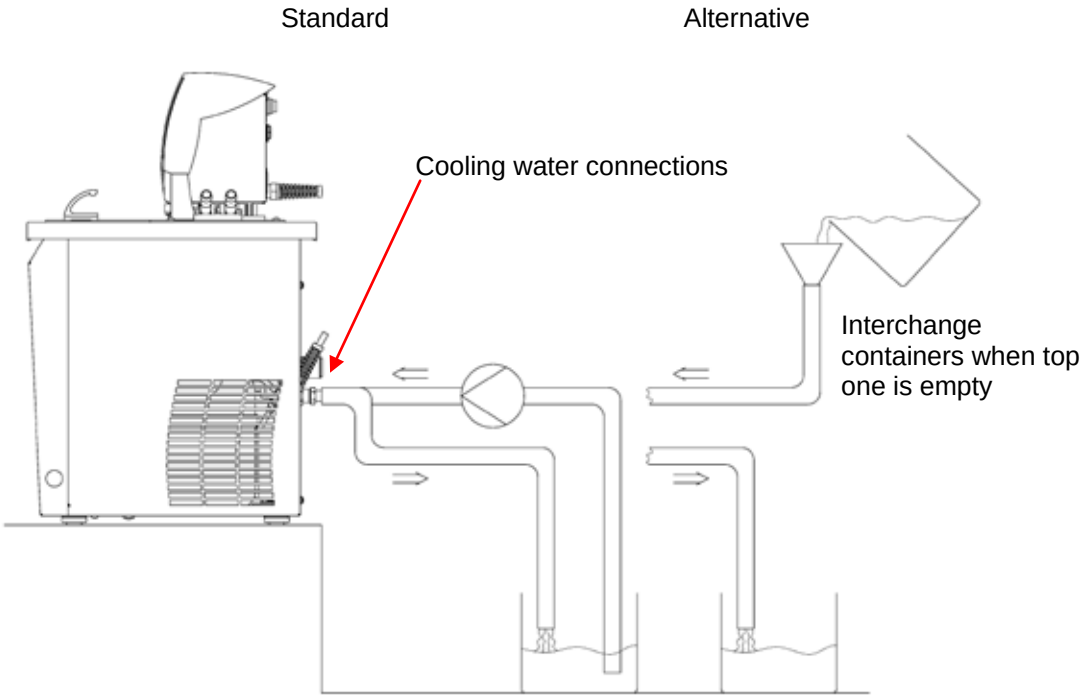
Place the drain hose as low as possible so that the unit can drain completely. Switch the unit off again immediately.

8.6.3 Decalcifying the cooling water circuit

At regular intervals of 3 months or longer (depending on the water hardness / degree of contamination of the cooling water) the water-cooled condenser must be decalcified or cleaned.

Required equipment:

- Two containers of 10 to 20 liters.
- Use a suitable pump (drum pump) or possibly use hose with a funnel with funnel located above the cooling water inlet.
- Hose between container, pump and cooling water inlet and also between cooling water outlet and container.



Via the water inlet hose, fill the device with decalcifier (pump or hose).
Set the set value to 10°C; after the chiller starts the water circuit can be filled.
Circulate the decalcifier with the pump or continue to top up the decalcifier. Allow the decalcifier to take effect (refer to table below).
Drain the unit. Reconnect the device to the water supply and thoroughly flush out (refer to table below).

Acting time	Continue the pump stage until most of the foamy reaction, usually at the start, has decayed. Generally, this is achieved after about 20 to 30 minutes.
Decalcifier	LAUDA article number: LZB 126 (5 kg) When handling the chemicals, the safety information and the instructions for use on the package are to be followed.
Flushing	Allow at least 30 liters of water to flow through.

8.7 Disposal information

The following applies to Europe: Disposal of the device may only be carried out by qualified specialists according to EC Directive 303/2008/EC in conjunction with 842/2006/EC.

The disposal is regulated by EC Directive 2002/96/EC.

Disposal of the refrigerant

The refrigeration circuit is filled with an CFC-free (FCFC) HCFC refrigerant. Type and quantity are marked on the refrigeration unit or on the rating label. Repair and disposal only by a qualified refrigeration engineer!

Global Warming Potentials (GWP) [cf. CO_2 = 1.0]	
Refrigerant	**$GWP_{(100a)}$ ***
R404A	3922

** According to EN 378-1: 2008 + A2: 2012, Annex E*
AR4: according to IPCC IV - time horizon 100 years – also basis for EU F-Gas Regulation 517/2014

The following applies to Europe: The disposal of the refrigerant must be carried out according to EC Directive 303/2008/EC in conjunction with 842/2006/EC.

Disposal of the packaging

The following applies to Europe: The disposal of the packaging must be carried out according to the EC Directive 94/62/EC.

8.8 Service and ordering replacement parts

Before you return the equipment for servicing it is advisable to contact our Technical Service department.

\+ - If the equipment has to be returned to the factory, please ensure that it is carefully and properly packed. LAUDA accepts no responsibility for damage due to unsatisfactory packing.

When ordering replacement parts, please state the serial number (rating label); this avoids queries and incorrect supply.

The serial number is combined like following, for example, **LWP101-15-0001**

LWP101 = article order number
15 = manufacturing 2015
0001 = continuous numbering

Your contact for service and support:

LAUDA Service Constant Temperature Equipment
Telephone: +49 9343/ 503-372 (English and German)
E-mail service@lauda.de

We are available any time for your queries and suggestions!

LAUDA DR. R. WOBSER GMBH & CO. KG
Pfarrstraße 41/43
97922 Lauda-Koenigshofen
Germany
Phone: +49 (0)9343 503-0
Fax:+49 (0)9343 503-222
E-mail info@lauda.de
Internet http://www.lauda.de

9 Technical Data

The figures have been determined according to DIN 12876.

			T 1200	T 1200 W	T 2200	T 2200 W
Working temperature range		°C	-25 ... 120 **(-25 ... 150 Option 1)**			
Ambient temperature range		°C	5 ... 40			
Setting resolution		K	0.1			
Temperature measurement			Pt100 outflow temperature and connection for external Pt100 via Lemo connector. Gr. 1			
Indication resolution		K	0.05			
Indication accuracy			± 0.2 K additive recalibration (ð Section 1.2)			
Temperature control		K	± 0.2 (ð Section 1.2)			
Safety fittings			FL (suitable for flammable and non-flammable liquids)			
Display			2-line LC display with various symbols			
Cooling control			automatic compressor control, proportional cooling			
Cooling capacity (eff.) with ethanol @ 20 °C ambient temperature resp. 15 °C cooling water temperature	20 °C 0 °C -10 °C -20 °C -25 °C	kW kW kW kW kW	1.2 0.8 0.6 0.18 0.1	1.6 1.1 0.7 0.25 0.1	2.2 1.8 1.0 0.6 0.35	2.7 1.9 1.4 0.68 0.42
Refrigerant			R404A			
Pump type			side-channel immersion pump			
Max. discharge pressure		bar	3.2			
Max. flow rate		L/min	40			
Pressure measurement		bar	0 - 7; digital display of pump pressure; adjustable bypass			
Pump connections			3/4" pipe thread, 15 mm i.d. for 3/4" hose			
Internal volume		L	3 ... 7			
Protection			IP 32			
Noise level (1m)		dB(A)	60	58	60	58
Condenser cooling			Air	Water max. 25 °C	Air	Water max. 25 °C
Airflow rate		m³/h	580	---	700	---
Power dissipated to air		kW	max. 2.4	approx. 0.4	max. 3.8	approx. 0.5
Cooling water connections			--	3/4"	--	3/4"
Cooling water consumption		L/h	--	0/150 ... 400	--	0/150 ... 600
Cooling water pressure		bar	--	> 2.5 … 10	--	> 2.5 … 10
Dimensions (W x D x H)		mm	450 x 550 x 790			
Dimensions with option 3 (W x D x H)		mm	450 x 580 x 830			
Weight		kg	77	82	89	94
Protection class			**Protection Class 1 to DIN EN 61140**			
Class according to EMC-standard DIN EN 61326-1 (a Section 1.2) notice valid for Europe			B	B	B	B
notice valid for the USA and Canada			A	A	A	A

		T 1200	T 1200 W	T 2200	T 2200 W
Heater power rating / power consumption @ 230 V; 50 Hz	kW	2.25 / 2.7	2.25 / 2.7	2.25 / 3.1	2.25 / 3.1
Heater power rating / power consumption @ 230 V; 60 Hz	kW	---	---	2.25 / 3.1	2.25 / 3.1
Heater power rating / power consumption @ 208 - 230 V; 60 Hz	kW	2.25 / 2.7	2.25 / 2.7	2.25 / 3.1	2.25 / 3.1
Heater power rating / power consumption @ 200 V; 50 Hz	kW	2.25 / 2.7	---	---	---
Heater power rating / power consumption @ 200 V; 60 Hz	kW	---	---	2.25 / 3.1	---
Catalogue number					
230 V; 50 Hz		**LWP 101**	**LWP 102**	**LWP 103**	**LWP 104**
230 V; 60 Hz		**---**	**---**	**LWP 203**	**LWP 204**
208 - 230 V; 60 Hz		**LWP 801**	**LWP 802**	**LWP 803**	**LWP 804**
200 V; 50 Hz		**LWP 811**	**---**	**---**	**---**
200 V; 60 Hz		**---**	**---**	**LWP 846**	**---**
Options:					
Enlarged temperature range up to 150 °C	**1**	**LWZ 029-1**	**LWZ 029-1**	**LWZ 029-1**	**LWZ 029-1**
Pump 5.5 bar; 40 L/min 50 Hz	**3**	**LWZ 031-4**	**LWZ 031-4**	**LWZ 031-4**	**LWZ 031-4**
Pump 5.5 bar; 40 L/min 60 Hz	**3**	**LWZ 031-5**	**LWZ 031-5**	**LWZ 031-5**	**LWZ 031-5**
Flow control instrument	**5**	**LWZ 035**	**LWZ 035**	**LWZ 035**	**LWZ 035**
Pump max. 1 bar 50 Hz	**6**	**LWZ 041-1**	**LWZ 041-1**	**LWZ 041-1**	**LWZ 041-1**
Pump max. 1 bar 60 Hz	**6**	**LWZ 041-2**	**LWZ 041-2**	**LWZ 041-2**	**LWZ 041-2**

The device conforms to the relevant fundamental requirements for safety and health of the following listed directives:

- EC Machinery Directive 2006/42/EC
- EMC Directive 2004/108/EC
- Pressure Equipment Directive 97/23/EC

We reserve the right to make technical alterations!

			T 4600	T 4600 W	T 7000	T 7000 W	T 10000	T 10000 W
Working temperature range		°C	-30 ... 120 **(-30 ... 150 Option 1)**					
Ambient temperature range		°C	5 ... 40					
Setting resolution		K	0.1					
Temperature measurement			Pt100 outflow temperature and connection for external Pt100 via Lemo connector Gr.1					
Indication resolution		K	0.05					
Indication accuracy			±0.2 K. additive recalibration					
Temperature control (ð Section 1.2 penultimate point)		K	± 0.2	± 0.2	± 0.3	± 0.3	± 0.3	± 0.3
Safety fittings			FL (suitable for flammable and non-flammable liquids)					
Display			2-line LC display with various symbols					
Cooling control			automatic compressor control, proportional cooling					
Cooling capacity (eff.) with	20 °C	kW	4.6	5.5	7.0	8.5	10.0	13.0
ethanol	0 °C	kW	2.8	3.4	5.0	5.5	7.3	8.7
@ 20 °C ambient	-10 °C	kW	1.9	2.3	3.0	3.9	5.1	6.0
temperature resp. 15 °C	-20 °C	kW	1.0	1.1	1.7	2.0	3.0	3.7
cooling water temperature	-30 °C	kW	0.2	0.3	0.5	0.6	1.2	1.5
Refrigerant			R404A					
Pump type external circuit			side-channel immersion pump					
Max. discharge pressure		bar	3.2 **(5.5 Option 3)**		6			
Max. flow rate		L/min	40		60			
Pump type internal circuit			Centrifugal immersion pump					
Pressure measurement		bar	0 - 7, digital display of pump pressure, adjustable bypass					
Pump connection			G3/4" pipe thread, 15 mm i.d. for 3/4" hose		G1¼" pipe thread, 20 mm i.d., for 1" hose			
Internal volume		L	6 ... 18		8 ... 20			
Protection			IP 32					
Noise level (1 m) Schalldruck		dB(A)	63	61	65	63	69	67
Condenser cooling			Air	Water max. 25 °C	Air	Water max. 25 °C	Air	Water max. 25 °C
Airflow rate		m³/h	2250	---	2600	--	3600	---
Power dissipated to air		kW	max. 7.1	1.2	max. 12.5	ca. 1.5	17	ca.1.5
Cooling water connections			--	3/4"	--	3/4”	--	1”
Cooling water consumption		L/h	--	0/200 ... 1000	--	0/500 ... 1800	--	0/600 ... 2500
Cooling water pressure		bar	--	> 2.5 … 10	--	> 2.5 … 10	--	> 2.5 … 10
Dimensions (W x D x H)		mm	550 x 650 x 970	550 x 650 x 970	850 x 670 x 970	850 x 670 x 970	1050 x 770 x 1120	850 x 670 x 970
Weight		kg	123	128	175	180	235	242
Protection class			**Protection Class 1 to DIN EN 61140**					
Class according to EMC standard DIN EN 61326-1 (a Section 1.2) notice valid for Europe			A	A	A	A	A	A
notice valid for the USA and Canada			A	A	A	A	A	A

		T 4600	T 4600 W	T 7000	T 7000 W	T 10000	T 10000 W
Heater power rating / power consumption @ 400 V; 3/N/PE~50 Hz	kW	6.0 / 8.5	6.0 / 8.3	6.0 / 11.5	6.0 / 11.2	9.0 / 16.0	9.0 / 15.5
Heater power rating / power consumption @ 208 V; 3/PE~60 Hz	kW	6.0 / 8.5	6.0 / 11.5	---	---	---	---
Heater power rating / power consumption @ 400 V; 3/PE; 50 Hz	kW	6.0 / 8.5	---	6.0 / 8.3	---	---	---
Heater power rating / power consumption @ 440 - 480 V; 3/PE~60 Hz	kW	---	---	6.0 / 11.5	6.0 / 11.2	9.0 / 15.0	9.0 / 14.5
Catalogue number							
400 V; 3/N/PE~50 Hz		**LWP 205**	**LWP 206**	**LWP 207**	**LWP 208**	**LWP 209**	**LWP 210**
208 V; 3/PE~60 Hz		**LWP 305**	**LWP 306**	**---**	**---**	**---**	**---**
400 V; 3/PE~50 Hz		**LWP 505**	**---**	**LWP 507**	**---**	**---**	**---**
440-480 V; 3/PE~60 Hz		**---**	**---**	**LWP 607**	**LWP 608**	**LWP 609**	**LWP 610**
Options:							
enlarged temperature range up to 150 °C	**1**	**LWZ 029-2**	**LWZ 029-2**	**LWZ 029-3**	**LWZ 029-3**	**LWZ 029-4**	**LWZ 029-5**
Pump 5.5 bar; 40 L/min 50 Hz	**3**	**LWZ 032-4**	**LWZ 032-4**	**-----**	**-----**	**-----**	**-----**
Pump 5.5 bar; 40 L/min 60 Hz	**3**	**LWZ 032-5**	**LWZ 032-5**	**-----**	**-----**	**-----**	**-----**
Flow control instrument	**5**	**LWZ 035**	**LWZ 035**	**LWZ 036**	**LWZ 036**	**LWZ 036**	**LWZ 036**

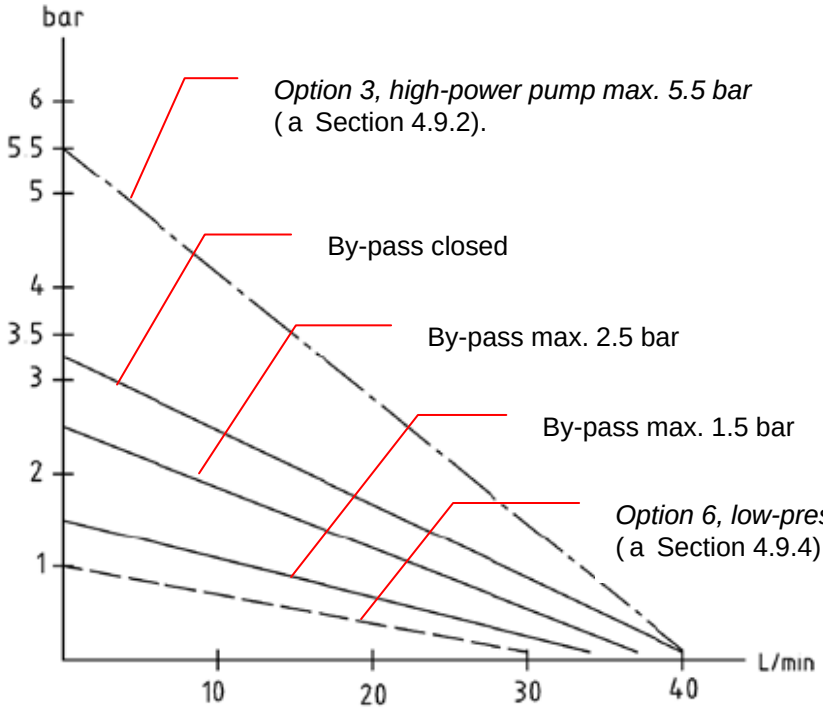
The device conforms to the relevant fundamental requirements for safety and health of the following listed directives:

- EC Machinery Directive 2006/42/EC
- EMC Directive 2004/108/EC
- Pressure Equipment Directive 97/23/EC

T 10000 (W) is classified into category II according to pressure equipment directive (DGRL) 97/23 EG.

We reserve the right to make technical alterations!

Pump characteristics:



Option 3, high-power pump max. 5.5 bar
(a Section 4.9.2).

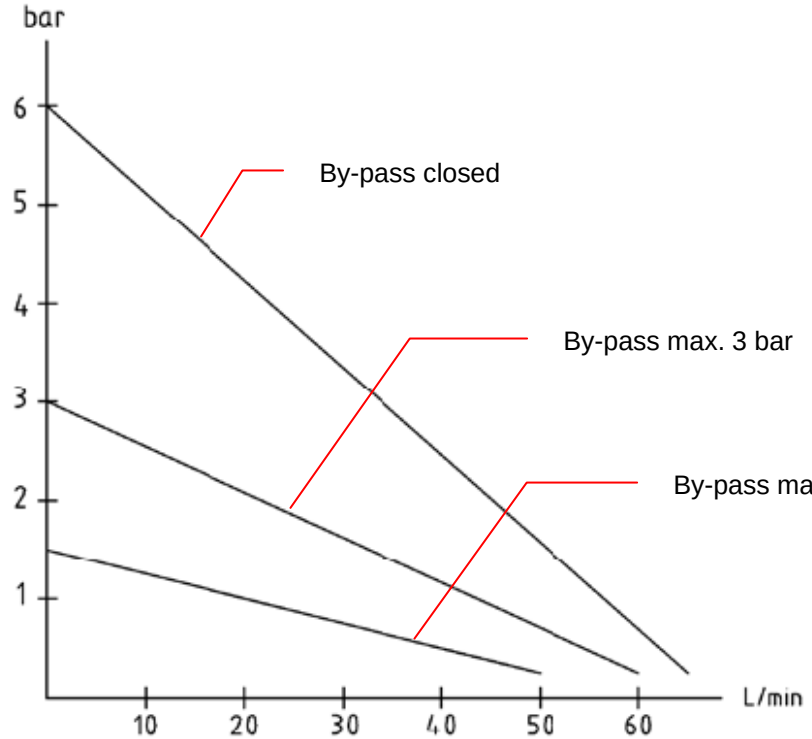
T 1200 (W), T 2200 (W), T 4600 (W)

By-pass closed

By-pass max. 2.5 bar

By-pass max. 1.5 bar

Option 6, low-pressure pump max. 1 bar
(a Section 4.9.4).



By-pass closed

T 7000 (W), T 10000 (W)

By-pass max. 3 bar

By-pass max 1.5 bar

10 Accessories

Accessories		Catalogue number
4-way manifold for pump outflow and return; each connection with separate shut-off.		
for units with 3/4" pipe connections / 3/4" hose	VT 2	LWZ 010
for units with 3/4" pipe connections / 1/2" hose	VT 3	LWZ 022
for units with 1-1/4" pipe connections / 3/4" hose	VT 4	LWZ 024
Hose/ screw fitting: brass nozzle 1/2" / Nut 3/4" for all units with 3/4" pipe thread.		LWZ 016

Metal hose insulated –60 ... 200 °C	
MTK 100 1 m long, G ¾, DN 20, G ¾.	LZM 075
MTK 200 2 m long, G ¾, DN 20, G ¾.	LZM 076
MTK 101 1 m long, G 1¼*, DN 25, G 1.	LZM 078
MTK 201 2 m long, G 1¼*, DN 25, G 1.	LZM 079
* for connection Integral	

Platinum resistance thermometers to DIN EN 60751.		
Pt100-70	Temperature range –200 ... 300 °C, 50 % response time 1 sec., 4 mm dia. length 250 mm, Accuracy Class A, Lemo plug.	ETP 009
Pt100-94	Temperature range –100 ... 200 °C, 4 mm dia., length 250 mm, Accuracy class A, with attached Silicone cable (2 m long) and 4-pin Lemo plug.	ETP 059
Clamping fitting 4 mm dia., suitable for Pt100-70 and Pt100-94.		HX 078
Connecting cable, 2.5 m long, Lemo plug suitable for Pt100-70 Cable length as specified		UK 246 UK 247
Remote control FBT, 1/3 19“; 4 elevation marks		LWZ 028
Housing for FBT		LWZ 027
Cable for Remote control FBT, length 5 m		EKS 057
Cable for Remote control FBT, length on demand max. 50 m		UK 258

For further accessories please contact us (a 8.8).

BESTÄTIGUNG / CONFIRMATION / CONFIRMATION

An / To / A:
LAUDA Dr. R. Wobser • LAUDA Service Center • Fax: +49 (0) 9343 - 503-222

Von / From / De :

Firma / Company / Entreprise: _____

Straße / Street / Rue: _____

Ort / City / Ville: _____

Tel.: _____

Fax: _____

Betreiber / Responsible person / Personne responsable: _____

Hiermit bestätigen wir, daß nachfolgend aufgeführtes LAUDA-Gerät (Daten vom Typenschild):
We herewith confirm that the following LAUDA-equipment (see label):
Par la présente nous confirmons que l'appareil LAUDA (voir plaque signalétique):

Typ / Type / Type :	**Serien-Nr. / Serial no. / No. de série:**

mit folgendem Medium betrieben wurde
was used with the below mentioned media
a été utilisé avec le liquide suivant

_____

_____

_____

_____

Darüber hinaus bestätigen wir, daß das oben aufgeführte Gerät sorgfältig gereinigt wurde, die Anschlüsse verschlossen sind, und sich weder giftige, aggressive, radioaktive noch andere gefährliche Medien in dem Gerät befinden.

Additionally we confirm that the above mentioned equipment has been cleaned, that all connectors are closed and that there are no poisonous, aggressive, radioactive or other dangerous media inside the equipment.

D'autre part, nous confirmons que l'appareil mentionné ci-dessus a été nettoyé correctement, que les tubulures sont fermées et qu'il n'y a aucun produit toxique, agressif, radioactif ou autre produit nocif ou dangeureux dans la cuve.

Stempel **Seal / Cachet.**	**Datum** **Date / Date**	**Betreiber** **Responsible person / Personne responsable**

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